Students’ university choice

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By

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Declaration

In accordance with the Regulations for Higher Degrees by Research, I hereby declare that the whole thesis now submitted for the candidature of Doctor of Philosophy is a result of my own research and independent work except where reference is made to published literature. I also hereby certify that the work embodied in this thesis has not already been submitted in any substance for any degree and is not concurrently submitted in candidature for any degree from any other institute of higher learning. I am responsible for any errors and omissions present in the thesis.

Candidate: ____

Marta Wanda Odendal

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Data used in this study has been provided by Higher Education Statistical Agency. HESA is not responsible for any inferences or conclusions derived from the data.

Abstract

This thesis addresses UK students' university choice using discrete choice methods and micro-data obtained from Higher Education Statistical Agency for graduates between 2006 and 2010. The thesis consists of three chapters with each addressing a different aspect of students' choice. The studies are intended to provide policy-makers and other decision-makers with valuable information that will help them to implement strategies and policies for better higher education. Some work in the literature has been dedicated to students' university choice. This thesis explores this body of work and builds on it, extends it and improves what is previously known in the literature.

The aim of the first chapter is to investigate what affects students' university choice. It contributes to the literature by establishing the best method to do so. Two models are used: the standard conditional logit and conditional logit with, what is called in this paper, alternative specific constants. Conditional logit with alternative specific constants improves on conditional logit twofold: it deals with unobserved university characteristics and improves the model fit. The results show that the probability of attending a university decreases with an increase in tuition fees and distance between students' home and the university, and decreases in students' socio-economic status.

The second chapter further investigates the importance of distance on students' university choice and it contributes to the literature by calculating the willingness to pay of students for distance to university. The chosen models are

estimated for different socio-economic group of students separately. This methodology allows for meaningful comparison between socio-economic groups and produces more reliable estimates due to the fact that it accommodates for different unobserved characteristics of universities for different groups of students. The results show that students with the highest socio-economic status are not affected or have a positive utility of distance. The willingness to pay of other socio-economic groups are mixed and depend on the university characteristics used in the model.

The third chapter focuses on students' attitudes towards costs and benefits of university degree by calculating the discount rate of future income using marginal utility of graduate income and tuition fees. In addition, the chapter shows how use of consideration sets of universities for each student improves the model fit. The results show that students have a normal discount rate around 1% without consideration sets. The discount rate becomes negative in all models apart from one, when consideration sets are used.

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Introduction-Why Students' university choice matters

This thesis is a result of my fascination with socio-economic mobility. The truism is that one can look at mobility from many angles. One of the issues many researchers concern themselves with is, how it can be achieved. This is also my concern. University education is considered to be one of the ways. In general, university education is an important step in an individual's life. For different reasons some decide to take this step, some do not. A considerable amount of research is dedicated to why an individual decides to continue their education at university level. Indeed, it is important to know what drives someone's decisions; however, it is often difficult to pin point the reason and the time of the decision, which makes robust analysis difficult. At the same time a lot of resources, like money and time, are spent to encourage individuals to attend universities. Nonetheless, little is known about what drives students' university choice. It suggests that policy makers see each university choice as the same. The research below is built around the idea that this cannot be true. The choice of university is important, as returns for students can vary between universities.

Higher education is often an indicator of higher wage, better health, and higher contributions to society. If more is known about what affects student's choice of university, students may be helped to make better decisions, and therefore the returns would be higher. It is viable to question whether a policymaker is paying for the university or if it is an individual expense. Efficiencies could be achieved if more is known about what drives individual choice. Also, policies could be designed to maximise the benefits of university choice and as a result, improve socio-economic mobility.

As little research exists concerning itself with the issue of university choice, I start with an “all in” approach, exploring all possible factors which could affect students’ choice. Then, a decision is made to focus on two: distance and tuition fees, which appear to be most important in the initial results and which are supported by previous research.

Chapter 1: Introduction to students' university choice in the UK

1.1 Introduction

This paper investigates the determinants of students' university choice with the UK as an example. Understanding the factors affecting university choice is crucial for better policy design, and could influence the discussion on whether higher education should be subsidised and how support packages should be distributed. The question I answer is whether there are differences in the choice of university between students from different socio-economic groups and between Scottish, English and Welsh students. The reason for differentiating between the nationalities is that it permits to compare the different university funding systems between the countries. Focusing on differences between socio-economic groups, I can look for behaviours which could perpetuate inequalities, like choosing universities, which are not as high quality because of their proximity.

The UK university sector is essentially public with the number of students admitted and tuition fees decided by the central government. The system remained relatively unchanged until 1998, when tuition fees were introduced in all UK universities. Subsequently, with increasing evidence of demand for university graduates from the labour market (e.g., Machin 2001) the government decided to increase substantially the numbers of students admitted (HEFCE 2001 Consultation 01/62). The policy was in line with the government promise to increase higher education participation. At the same time, the government had to look for ways to make this economically viable. It quickly became apparent that the 1998 introduction of means tested up front tuition fees, of £1000 per year, was not sufficient. The student numbers were increased every year, as the government boosted the supply of places at universities (Universities UK 2011), which meant the government's university spending continued to be a significant outlay in the budget[1]. In 2006, the English Government changed their funding scheme by removing means testing and substituting it with deferred tuitions fees, which could be paid with guaranteed government subsidised loans. All students were able to access these loans and they did not have to be repaid until a certain threshold of income was earned[2]. At the same time, tuition fees increased to a maximum of £3000. However, since 2000, Scottish students have not had to pay tuition fees, neither in Scotland nor in the rest of the rest of UK (rUK). This changed once the higher fees were introduced in 2006; after that time, Scottish students who want to study in England are treated in the same manner as English students, and therefore are eligible for government subsidized student loans. These changes to both costs and funding structure raise a host of important policy questions.

[1] According to OECD, in 2010 the UK spent 1.4% of its GDP on tertiary education
[2] First, the amount was £15,000 and it was increased to £18,000

The focus of this research is the determinants of university choice as these can contribute to students' wages and employment opportunities for example, Dale and Kruger (2002) and Chevalier and Conlon (2003) show the importance of university characteristics on students earnings. On the other hand, many factors can affect students' university choice, such as financial aid, positive discrimination (Arcidiacono (2005)), home/institution distance (Gibbons and Vignoles 2012) and quality of the university (Long (2004) and Drewes and Micheal (2006)). This paper contributes to the literature by combining a precise measure of home/institution distance for the whole of the UK with tuition fees, university characteristics, and students' demographic information using alternative-specific-constant random utility model framework.

Specifically, the focus is how home/institution distance interacted with characteristics of individuals, chosen universities and tuition fees affect students' choice of university. The inclusion of tuition fees in the choice model is an important contribution, as omitting them could bias the estimation of the distance coefficient due to variation of fees between Scotland and rUK. Thus, the inclusion of tuition fees in the model provides additional robust identification strategy.

The model I used in the paper is based on the Random Utility Theory (RUT), initiated by Thurstone (1927) and generalized by McFadden (1974). The specification I used is a conditional logit. My model is an extension of the model used by Gibbons and Vignoles (2012), in which they used binomial logit model to investigate students' choice of university.[3] For comparison purposes, I also use the same socio-economic group classification as used in Gibbons and Vignoles (2012). In addition to these extensions, I used alternative-specific constants (Berry *et al*. 1995) to deal with unobserved university characteristics, which have been overlooked in the literature.

The data used in the analysis come from the Higher Education Statistical Agency (HESA) data, which is unique. It includes the whole population of graduates in the UK between 2006 and 2010. It gives me the confidence that the results are nationally representative. Specifically, I use the dataset which only includes British domicile students who graduated with an undergraduate degree. The demographic information on each student is known, as well as, students' final high school test scores, which in the HESA data is itself approximated by the Universities and Colleges Admissions Services (UCAS) tariff. The chosen university and the postcode sector of each student at the time of enrolment are also known. The individual level data is necessary to calculate the distance and it allows me to model the decision process based on location. The HESA dataset is merged with collected university characteristics, as well as, with information on potential fees to be paid for by each student, depending on university choice and the country in which the university is located (England, Scotland or Wales).

Results from the analyses show that (1) probability of choosing a university increase with distance for "Professional" background students;

[3] In the working versions of their paper, they use a conditional logit framework.

however, it decreases for all lower socio-economic background students; (2) it also decreases as tuition fees increase; (3) all students, in comparison to the reference group (male students from a ”Professional” background) have a decreasing probability of attending the Russell Group universities, which are similar to Ivy League universities in the USA and is an approximation of university quality; (4) sensitivity checks are run to identify the reason for this result. The results also show that moving from a simple conditional logit model (CNL) to the alternative-specific logit model (CNL-ASC) improves the model fit statistic, ρ^2.

This paper progresses as follows: section 1.2 discusses previous literature on the subject of student university choice and returns to education. In section 1.3, I present the background of the UK university education system. Section 1.4 discusses the data. Sections 1.5 and 1.6 discuss methodology and estimation results, respectively. Section 1.7 concludes.

1.2 Literature Review

This section gives background information on university characteristics and students' future returns, and factors that determine students' university choice.

1.2.1 The university quality and students' future returns

First, it is important to point out the particularity of the university funding system in the UK means that public universities receive the same amount of funding per student per subject within each UK country. The tuition fees are set by the government, and are essentially the same for all universities within a country and therefore costs of universities are not a representative of university quality on their own. The university teaching funding is thus not directly related, e.g., to university teaching performance and, in particular, different teaching arrangements, like student/staff ratio, curriculum, etc. This is partially qualified by Belfield and Fielding (2001) who suggest that only 1%-2% of the students' wage differential can be explained by differences in university resources. Still, universities have a relative amount of freedom regarding how teaching is delivered. The tutorial system[4] at the University of Oxford and the University of Cambridge is one of the particularities which are not affected by the funding received, but more by tradition.

Nonetheless, there are differences in quality[5] of university in the UK and this study is based on the assumption that where students' choose to study is important, as students' returns on degree vary by university quality. The literature suggests that students who attend a prestigious university are likely to have higher wages following graduation in the UK (Chevalier and Conlon 2003). More recent research by Hussain *et al* (2009) suggests a positive return to university quality, with results increasing non-linearly at the top of the university quality distribution that is, benefits of attending one of the top universities offers much higher returns, in comparison with attending just a good university. Elsewhere in Europe,

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[4] This type of supervision system is based around a tutor who meets with small groups of students, 1 to 3, every week, where they are able to discuss and critique their own work and the work of their fellow students

[5] Here, quality can mean either students' quality as a peer group or university quality based on the quality of academic staff

Holmlund (2009) looks at the relationship between institution quality and students subsequent earnings in Sweden. Her results are mixed and may be due to possible correlation between different quality measures she uses.

In the USA, Dale and Krueger (2002) using a regression analysis apply two new methods to adjust for non-random selection of students who attend elite universities. They show that the quality of university does not affect selective universities' students' future income, but the best predictor of subsequent wages is the university average tuition fees, where the assumption is that tuition fees are some type of a signal of quality. Monks (2000) uses ordinary least squares (OLS) and finds students from selective, private and graduate degrees granting universities earn higher wages. He finds mixed results from quality for gender and race, with non-white and men benefiting more from a better university. Using the same data[6] Long (2008) finds mixed results depending on the method used. She finds wages of men are more affected by university quality than those of women, but as she concurs, it may be due to the data used. Finally, using propensity score matching, Black and Smith (2004) find that there still appears to be a quality effect on wages. They find their matching results to be insignificant in comparison to OLS. They assign it to the data limitation.

1.2.2 Determinants of students' university choice

The seminal work into the determinants of students' university choice has been

[6] Both studies use the National Education Longitudinal Study, though they use different sweeps.

done by Fuller *et al* (1982). They look at a variety of university characteristics and find that university costs have a negative effect on student's utility of choice. Also, they investigate the importance of home-university commuting distance, but they find a very small effect, which they attribute to potential issues with calculation of their distance. It is more likely they do not find a strong significant effect due to small actual commuting distances. It is not surprising that students choose universities within a reasonable commutable distance, and hence they do not find the distance to be a large cost. Also, through their study, due to computational limitations of the time, they use a simple McFadden (1974) conditional logit. A similar method to Fuller *et.al* (1982) can be found in Nguyen and Taylor (2003). Nguyen and Taylor (2003) use a multinomial logit for the analysis of the choice after high school graduation with choices varying between employment, unemployment, private four-year college, public four-year college, private two-year college and public two-year college. They find that, amongst other things, students with higher ability, being from a "Professional" or "Managerial" and higher income backgrounds increases the probability of attending a 4 year college. Their results for distance are mixed, potentially due to the aggregate data they use.

Long (2004) looks at how university decisions changed over time in the USA. She presents her results as odds ratios, where results below one represent a less likely probability of outcome. Over the three decades 1972, 1982 and 1992, she finds tuition fees to continue to be an important determinant of students' university choice, especially amongst students from low income backgrounds.

Additionally, she finds the quality of institution has grown in importance over the years. The odds ratios are close to one for distance to university, with the odds increasing over time i.e. the importance of distance decreased slightly over time. Arcidiacono (2005) looks at how financial aid and affirmative action affects black students' decision. He models four stages in a dynamic model including a stage where the admission office decides whether to accept a student. He starts with the decision to participate in higher education and as the next stage, he includes university and course choices. The final stage is the labour market outcomes of students who would be affected by financial aid. He shows the importance of advantages in financial aid for the general college attendance, and that affirmative action has a positive effect on the black students' attendance of top-tier universities. He offers a very thorough analysis; however, in his discussion, he does not control for distance and his sample size is also rather small and potentially non-representative (some of these points may be attributed to the econometric methods used, which are computationally intensive).

Drewes and Michael (2006) look at the effects of different university characteristics on students' university preferences, using application data from the province of Ontario in Canada. They know how students ranked their universities choices and using a rank-ordered logit they calculate elasticities of university being ranked first depending on different university characteristics. They find distance to play a negative and significant role, and that universities which spend more on financial aid are more preferred. Some of their results are harder to explain, for example they find that research quality has a negative, inelastic effect on students' preferences towards university; they also find a negative effect of university ranking on preference. These results could be due to the higher entrance requirements of these universities, which discourages students on average from ranking them as preferred. It could be because of risk averseness regarding dropping out, but also having lower expectations, etc.

The most notable research into the choice of university based on distance is that of Gibbons and Vignoles (2012).[7] They show that distance to universities is an important factor of choice for students from lower socio-economic backgrounds. Specifically, they derive elasticities of university choice with respect to distance for each group separately. They use binomial logit. In their method they apply 1 for the chosen university and 0 for all other options and then take the inverse variance weighted means to calculate the population parameters. This method may exaggerate the importance of distance for the university of choice. For example, if the distance to that university increases by 1km, in reality the distance to another university will decrease. Using a binomial model fails to account for an improvement in attractiveness of the other university, and the effect is combined with the distance coefficient for the university in question, exaggerating the probability that students will not choose this university as distance increases. Also, elasticities estimated separately for groups (by gender, socio-economic group and ethnicity) are not comparable between each other.

The next section describes the university system in the UK.

[7] Also, see Gibbons and Vignoles where they use a conditional logit in the same model structure (2009).

1.3 University Education in the UK

All residents of the UK, which comprises of England, Scotland, Wales and Northern Ireland, can study at institutions in any of the four countries but the university education systems and tuition charges vary. First, the bachelor with honours degree, which is a typical undergraduate degree, takes four years in Scotland, whereas it only takes three years in the other three countries. The second most important difference is the way students are funded. Until 1997, higher education in the UK had been free and overseen by the central government of the UK. In 1997, the report by The National Committee of Inquiry into Higher Education, referred to as the Dearing report, was published, recommending the introduction of tuition fees. In 1998, the recommendation for fees was passed as law by the UK government. Students entering university in the autumn of 1998 were expected to pay a fee of £1000 per year (inflation adjusted) and this applied to all four countries. The payment was upfront; however, means testing was also introduced. Anyone whose parents earned above £35,000 was subject to the fees. Students from families who earned between £23,000 and £35,000 had to pay a fraction of the fees on a sliding scale. Finally, students whose parents had a total income below £23,000 did not have to pay fees. Moreover, English, Welsh and Northern Irish students were to pay for the fourth year at Scottish universities. At the same time, the Scotland Act (1998) was passed, which devolved some executive powers to Scotland including higher education funding. In 2000, tuition fees were abolished in Scotland and a year later, the graduate endowment (a one off payment to the university following graduation) was introduced where students beginning university education after August 2001 would have to pay £2,000 10 months after their graduation[8]. The graduate endowment was increased to £2,289 in 2006. It was abolished in the following year and thus all students who graduated after April 2007 did not have to pay it.

Table 1.1

UNIVERSITY TUITION FEES IN SCOTLAND, ENGLAND AND WALES

Scottish students studying in:

Year	Scotland	England	Wales
2002	£0	£0	£0
2003	£0	£0	£0
2004	£0	£0	£0
2005	£0	£0	£0
2006	£0	£9000	£3600

	English students studying in:			*Welsh students studying in:*		
Year	Scotland	England	Wales	Scotland	England	Wales
2003	£4400	£3300	£3300	£2510	£1410	£1410
2004	£4500	£3375	£3375	£2610	£1485	£1485
2005	£4600	£3450	£3450	£2710	£1560	£3450
2006	£4700	£9000	£3525	£2810	£7110	£3525
2007	£4800	£9000	£9000	£2910	£7110	£7110

Amounts are per country of residence and per country of university. The numbers represent total costs of obtaining a degree. Years refer to enrolment years. In my analysis, I use year of graduation but because Scotland has four-year degrees, the Scottish students enrol a year early in my sample, in comparison to the rest. Numbers in the table represent the cost of the whole degree (three years in England and Wales, four in Scotland). Welsh tuition fee costs are net of the Welsh Government grant.

In 2006, English tuition fees were increased to £3,000 per year and this is the quasi- experimental change I exploit in the model as it led to changes in Scotland, which caused the two systems to diverge. On the one hand, in England,

[8] The repayment trigger date for the first cohort was 1st April 2006

means testing for fees disappeared but all students became eligible for a student loan, which they did not have to repay until they graduated and earned at least £15,000 with the government subsidising the interest above the inflation level. Means testing was now applied to support packages to help with the cost of living. When tuition fees in England increased in 2006, Scottish students wanting to study in England had to pay these fees, but could still study for free in Scotland. Table 1.1 presents the variation in tuition fees over the data sample. The fees vary by individual's residency status and by university, i.e. the students' choice set of fees depends on where they are from, what year they enrol and in which country the institutions are located. For example, a Scottish student who in 2003 would decide to study in Scotland or England would not have to pay anything for a degree. At the same time, an English student who would want to study in Scotland would have to pay £4400 to obtain a degree but only £3300 if he/she wanted to study in England. The amounts in the table reflect the total costs of obtaining a degree. For an overview of the issues regarding tuition fees in England see Barr (2004).

1.4 The Data

1.4.1 General

Higher Education Statistical Agency (HESA) is a quasi-governmental (quango) statistical agency, which collects data on students at public universities[9]. Since the

[9] There is only one private higher education institution, the University of Buckingham, with a negligible number of students

organisation is a quango, all public universities are required to provide it with information. The data I have hold information on graduates between years 2006-2010. As the data are provided by HESA, it is expected that the whole population of students for this period is included. After the basic cleaning up, the sample consists of over 2,300,000 individuals over 5 years. This sample also includes international students and postgraduate students but they are not used in the analysis, as their tuition fees situation is different. Therefore, only students whose nationality is British and who graduate with an undergraduate degree are kept, which leaves over 1,960,000 students. Also, only students whose addresses are known are retained because addresses are necessary to calculate the home-institution distance. In the analysis, home is the postcode sector of the address of students during the enrolment process. Postcode sector represents aggregation of one level up from the postcode itself and it is sufficiently small to give unbiased results on distance. There are many islands surrounding the UK, which can be identified by their own postcode sectors. The number of students who do not live on the UK mainland is very small, and they are left out of the analysis for now, as they would require an additional consideration due to additional costs of crossing the water. The same approach is taken regarding students with addresses in Northern Ireland. Only a very small proportion of observations are lost to wrongly coded data. I hold information on students who enrolled between 2002 and 2007 depending on the country of university. The enrolment years are 2002 to 2006 for Scotland and 2003 and 2007 for England and Wales. This is a reflection of the length of course as the information I hold is recorded at graduation year and includes graduation years 2006 through to 2010 inclusive.

1.4.2 Individual characteristics

In model estimations, I used data from around 230,000[10] students. The data include information on students' university choice, as well as their age, gender, test scores (approximated by UCAS tariff based, amongst other things, on students' end of high school exams), socio-economic class based on their parents' occupational code and ethnicity. For students over the age of 21, socio-economic class is recorded based on their own occupation. As HESA does not include detailed information on nationality, I use students' addresses before enrolment to distinguish between English, Scottish and Welsh. This approximation of nationality is necessary, as students only qualify for tuition fees support if they meet the residency condition. This condition requires a UK student to live in Scotland for three years prior to their application to be eligible for tuition waiver in Scotland. Where they are born within the UK is immaterial. So, although it is really the domicile address that I observe, for simplicity it is referred to it as students' nationality. This is not expected to be a major problem as it is very unlikely that students would have moved between Scotland and England anytime close to enrolment, as the last 3 years of high school are crucial for preparation for entrance examinations. These are vital for achieving enrolment.

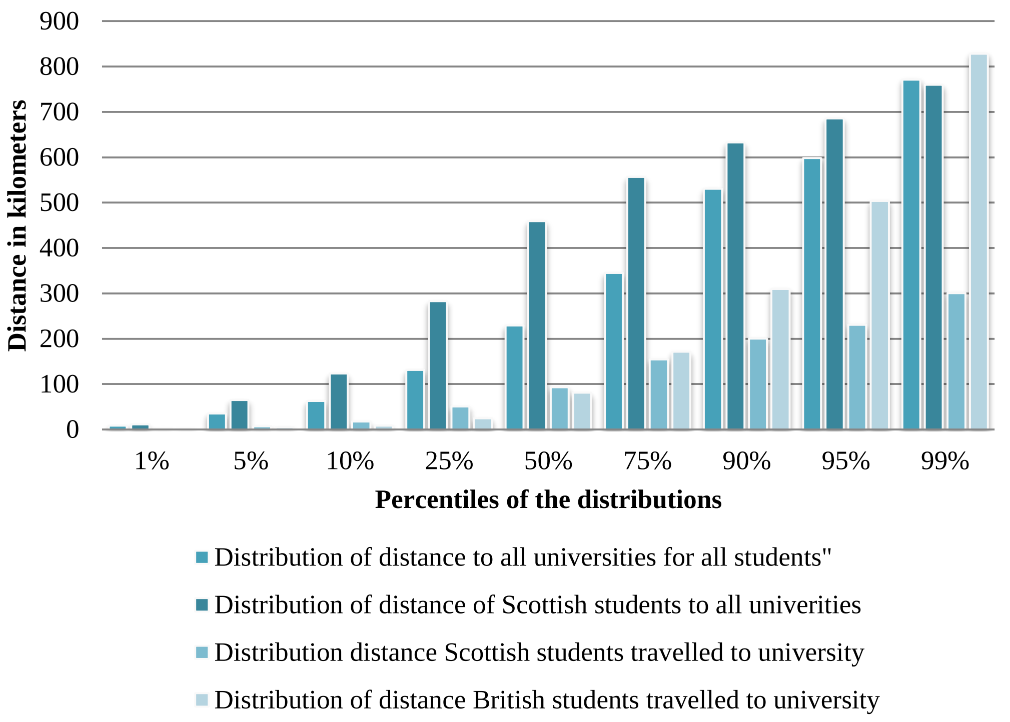
Test results vary from 5 with a maximum recorded in the data at 1080[11].

[10] The number is rounded up to comply with the HESA data release requirements
[11] As test scores are approximated by UCAS tariff, there is no maximum binding them

The lower bound test scores are not coded in error but rather they imply unconventional admission. The mean and median age of students in the sample is 18. Additionally, 57% of the students are female. The average and median test results are around 322 and 320, respectively. In this paper, I distinguish six socio-economic statuses (SES): “Professional”, “Managerial”, “Administrative”, “Skilled Trade”, “Other” and “No Occupation” where “Other” represents all occupational codes above “Skilled Trade”, and “No Occupation” represents students whose parents are unemployed or have occupation information missing. The 34% of students in the sample are from the “Professional” background, which is the highest SES and includes professions like medical doctors and lawyers. 20% of students are from the “Managerial” background. Students whose parents are from ”Administrative” and “Skilled trade” backgrounds make up approximately 8% and 9% of the sample respectively, while “Other” and “No occupation” comprise 14% and 15% of the sample. The data also include information about students’ ethnicity, but it is not used in this analysis. I do not have information about parental income, and therefore I cannot make assumptions about potential support packages; however, socio-economic status is a very good approximation of these packages, as incomes are closely correlated with SES. Therefore, indirectly, using SES dummies allows for control for these in the estimation (Long 2004).

Figure 1.1

DISTRIBUTION OF DISTANCES TO UNIVERSITIES



The distance between home and a university is treated as an approximation for moving costs. How distance is calculated in detail can be found in the Technical Appendix. The average distance travelled from home to university of choice is approximately 132km; however, these averages vary by nationality. English students travel on average 136 km to their university of choice. This distance drops substantially for Scottish and Welsh students to 83km and 112km respectively. It would suggest that Scottish and Welsh students have preference towards universities closer to home, or that they are less willing to move further away to study. After the investigation of the distribution of universities in relation to students, I find that this result is to some extent driven by the fact the last percentile of British students travels much further than the rest, which is also driven by the distribution of universities in the UK. This is visually represented in Figure 1.1, where it can be seen that last 10th centiles of the British students travel, on average, much further than Scottish. When looking at median distances, they are approximately 84km, 39km, and 64km, for English, Scottish and Welsh, respectively. The descriptive statistics suggest that Scottish students choose to stay closer to home, even though they do not have to pay tuition fees for universities in the rest of the UK, for most of the sample.

As seen in Table 1.2, the distance travelled varies by socio-economic background. Students, based on their socio-economic classes, move on average following distances: ”Professional” 146 km, “Managerial” 139 km, “Administrative” 129 km, “Skilled Trade” 120 km, “Other” 101 km. Finally, students from “No Occupation” SES travel on average 127 km. This is potentially due to the fact “No Occupation” includes students whose SES information is missing. In general, there is a clear pattern that shows the decreasing distance travelled with decreasing SES. In terms of gender differences on the distance travelled, the data shows that on average women travel 16 km less than men.

Table 1.2

INDIVIDUAL CHARACTERISTICS DESCRIPTIVE STATISTICS

	Mean	Std. Dev	Median	Min	Max
Descriptive statistics for the whole sample					
Test results	322	122	320	102	1080
Age	18	2.01	18	16	65
Distance	132	166	81	0.055	908
Distance travelled to universities of choice in km by Socio-Economic Status					
Professional	146	164	100	0.05	1008
Manager	139	166	96	0.07	978
Admin	129	165	79	0.05	1017
Skilled trade	120	164	68	0.16	1022
Other	101	150	49	0.08	999
No occupation	127	182	56	0.07	1022
Distance travelled to universities of choice in km by Nationality					
English	136	169	84	0.07	1022
Scottish	83	118	39	0.05	831
Welsh	112	139	64	0.38	845
Distance travelled to universities of choice in km by Gender					
Women	125	161	75	0.05	1022
Men	141	173	89	0.05	1022
Test scores by Socio-Economic Status					
Professional	348	121	350	5	1080
Manager	335	118	336	10	985
Admin	326	121	320	10	850
Skilled trade	308	115	300	10	820
Other	289	119	280	10	960
No occupation	284	122	280	7	880

	Percentage
Demographic composition of total sample by Nationality	
England	90%
Scotland	5%
Wales	5%
Demographic composition of total sample by Socio-Economic Status	
Professional	34%
Manager	20%
Admin	8%
Skilled trade	9%
Other	14%
No occupation	15%
Demographic composition of total sample by Gender	
Female	57%

Source: HESA Student Record 2009/10 Copyright Higher Education Statistics Agency Limited 2011. Age censored at 16 and 65. Distance in kilometres

I also look at differences in student participation by socio-economic groups at Russell Groups (RG) universities, where the Russell Group variable approximates quality in the study. Table 1.3 shows that students from lower socio-economic backgrounds especially from the very bottom of the scale, “Other” and “No Occupation” are underrepresented. As it could be due to higher test scores requirement, I look at average test scores for these universities. They are calculated using test scores available for students who graduated from these universities. Table 1.4 shows that amongst RG universities, the test score varies from 388 to 537 points whereas the difference of mean test scores between the highest and the lowest SES, as found in Table 1.2, is only 64 points with students from “Professional” backgrounds averaging around 348. Even with one standard deviation, an average student from professional background would not necessarily get accepted into the University of Oxford or the University of Cambridge based on their test results. This suggests that there are other factors present, which may be responsible for underrepresentation of lower socio-economic groups within these universities. Especially that standard deviation of test scores amongst those universities is around 40 points smaller than when test scores are calculated per SES.

The full dataset contains information about students who did not graduate. This is not a problem for this study as the final dataset does not contain any drop outs. It suggests that drop outs require a separate analysis which is not in the scope of this study.

Table 1.3

DISTRIBUTION OF STUDENTS IN RG AND NON-RG UNIVERSITIES BY SES

	Professional	Manager	Admin	Skilled Trade	Other	No Occupation
Non-RG	30.58%	19.39%	7.82%	9.29%	15.50%	17.41%
RG	44.39%	22.53%	8.24%	6.67%	8.96%	9.22%

Source: HESA Student Record 2009/10 Copyright Higher Education Statistics Agency Limited 2011. Percentages represent the proportion of students from this particular socio-economic group per RG or non-RG universities

Table 1.4

DISTRIBUTION OF TEST SCORES BETWEEN RG UNIVERSITIES

	Mean	Std. Dev.
The University of Birmingham	391	84
The University of Bristol	446	88
The University of Cambridge	537	98
The University of Leeds	394	84
The University of Liverpool	371	86
Imperial College London	465	95
King's College London	404	82
London School of Economics	478	90
University College London	437	88
The University of Newcastle	393	88
The University of Nottingham	428	87
The University of Oxford	519	89
The University of Sheffield	410	82
The University of Southampton	400	80
The University of Warwick	463	92
The University of Edinburgh	421	92
The University of Glasgow	400	89
Cardiff University	388	79
The University of Manchester	413	88

Source: HESA Student Record 2009/10 Copyright Higher Education Statistics Agency Limited 2011.

1.4.3 University specific characteristics

Additional information on universities was added to the sample. The total sample has over 170 universities, but some of them did not enrol any undergraduates or enrolled too few to give meaningful results. Some universities changed names or merged with others over the time of our sample[12]. All this is taken into account during the analysis and so only institutions which enrolled at least 10 students over 5 years and enrolled at undergraduate level, are included. In the analysis, there are 146 universities; 12 in Wales, 17 in Scotland and the rest are in England. I collect information on the address of each university and using this information I match them to regions and cities in the UK, which gives an approximation of living costs etc. There are twelve regions in the UK. Scotland and Wales each comprise one region, whereas England is made up of nine. For now, I exclude universities or students from Northern Ireland. London is considered a separate region. Also, I include a dummy variable for universities, which are part of the Russell Group. The Russell Group (RG) represents "leading universities in the UK"[13]. The RG group is up to date as of the 2010. Over past few years, new universities joined the RG but they are not included, as they were not a RG university at the time of our sample. For comparison purposes, I also generate a dummy variable for Top 20 universities of 2010. A small group of universities are considered Ancient[14], i.e. they were established pre-17th century. A dummy for this group is an approximation of both esthetical values of campus, which include historical buildings, as well as quality of teaching. Subsequently, I move onto estimation methods, which will help me in analysing these differences.

[12] Details can be found in Appendix 1A
[13] Extract from http://www.russellgroup.ac.uk/
[14] These universities are in the order they were established: University of Oxford, University of Cambridge, University of St. Andrews, University of Glasgow, University of Aberdeen and University of Edinburgh.

Table 1.5

TOP 20 UNIVERSITIES IN THE UK

University of Bath
University of Bristol
University of Cambridge
Durham University
University of East Anglia
University of Edinburgh
University of Exeter
Imperial College
King's College
London School of Economics
University College London
Loughborough University
University of Manchester
University of Nottingham
University of Oxford
University of Sheffield
University of Southampton
University of St. Andrews
University of Warwick

Universities are in alphabetical order

1.5 Model and Methodology

Discrete choice models are widely used to elicit the preferences and choices between alternatives. The modelling framework used in the paper is based on the Random Utility Theory (RUT), initiated by Thurstone (1927) and generalized by McFadden (1974). The specification I used to calculate the determinants of university choice is a simple conditional logit (CNL). I use logit framework to calculate the determinants of university choice because of the flexibility which arises from the assumption that the unobserved components of utility ε_{ij} are independently and identically distributed (*i.i.d.*) extreme value. Specifically for my model, each student i chooses the university j from a set of J universities. Each student's choice is driven by his socio-economic background, university characteristics, other demographics, tuition fees and home/institution distance. Their choice is assumed to maximise their utility. I assume that students make a decision from the full set of universities as I do not have information on each student's consideration set (i.e., universities that they applied to and they were accepted). Additionally, I calculate conditional logit with alternative-specific constants (CNL-ASC) to deal with unobserved heterogeneity of universities. Sections below describe these two models in more details.

1.5.1 Conditional logit

Conditional logit (CNL) is one of the easiest and the most widely used discrete choice models (Train, 2003, p.34). By using the CNL specification, I investigate students' university choice. The model is based on the Random Utility Theorem (McFadden, 1974) that describes student i's utility from choosing a university j among J other institutions is the following:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

where U_{ij}, is observed to the individual where V_{ij} is part of the utility that is observed to the researcher. This deterministic, observed part of the utility can be explained as the following:

$$V_{ij} = \beta_1 lndist_{ij} + \beta_2 X_j + \beta_3 lndist_{ij} Z_i + \beta_4 X_j Z_i + \\ + \beta_5 lndist_{ij} X_j + \beta_6 (tuitionfees_{ij} * lndist_{ij}) \tag{2}$$

where $lndist_{ij}$ is the natural logarithm of home/institution distance for each student *i* to university *j*. Natural logarithm of distance is used to deal with potential non-linearity in the utility due to the costs of distance and it ensures that the students' probability of attending universities will decrease with distance, and at the same time the importance of distance will decrease exponentially. X_j are the observed characteristics of university j, Z_i are the observed characteristics of student *i*. $tuitionfees_{ij}$ are the fees a student *i* would pay for studying at a university *j* given his residency status. ε_{ij} are unobserved components of the utility, which are *i.i.d.* type 1 extreme value. This simple logit model allows me to calculate the utility of university choice based on the observed characteristics of students and universities, as well as the home-institution distances. The McFadden logit only identifies coefficients, which vary by alternatives[15]. Therefore, to learn how demographic characteristics of students affect university choice, they are interacted with distance, or other university specific variables, as shown in eqn. (2). Given this information about each student and each university, the probability of student *i* choosing a university *j* is given as the following:

$$P_{ij} = \frac{exp(V_{ij})}{\sum_{k=1}^{J} \exp(V_{ik})} \tag{3}$$

I then maximise the log likelihood function of equation (3) to estimate its parameters

[15] For more details on identification in McFadden framework, see Technical Appendix

$$\text{LL}(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6) = \sum_{i=1}^{I} \sum_j y_{ij} \ln P_{ij} \tag{4}$$

where y_{ij}=1 if an individual *i* chooses institution *j*, and 0 otherwise.

The CNL I use explains students' university choice and also describes how the choices vary with students' demographic characteristics. Furthermore, it includes the whole choice set of universities within the model, which is one of the important contributions of my research. Including the whole choice set allows for full substitutability between alternatives and takes account of the fact that any change in the distance to one university leads to changes in the distances to all other universities. Ignoring the full choice set may bias the estimates of distance upwards.

Although a simple CNL helps to understand students' choices, it does not deal with the unobserved characteristics of university choice like, for example, engaging university social life. Ignoring this may misrepresent the preference and skew the importance of distance on the (dis)utility of choice, and thus may result in biased coefficients. Therefore, the next step is to extend the CNL estimation strategy to include alternative-specific constants that account for this unobserved, university-specific heterogeneity. The section below describes this new approach to explaining students' university choice.

1.5.2 Alternative-specific constants model

The conditional logit with alternative-specific constants (CNL-ASC) model used here is an extension of the CNL described above. It is a conditional logit with alternative specific constants using the Berry, Levinshon and Pakes (BLP) (1995) method, which is an important contribution of this paper.

The BLP method has been developed in the context of industrial organisation issues, specifically calculation of demand and cost parameters. It has been generalized to location choice discrete models by Bayer and Timmins (2007). Berry *et al* (1995) were concerned with two problems. First, they raised the issue of substitution patterns of cross-price elasticities, which results from the imposed functional form of utility due to its additivity seperability and *i.i.d.* of unobserved components of utility, ε_{ij}; however, this paper is not concerned with the analysis of substitution patterns between universities. Second, they were concerned that amongst other things, prices of goods can be correlated with unobserved product characteristics, and the bias it induces.

In this paper, instead of prices, I have tuition fees and other characteristics, and instead of goods, I have universities, where tuition fees include the whole cost of university. The method allows me to deal with the issue of unobserved university characteristics, which are proven to affect both the sign and the size of coefficients in estimation. For this reason, unless alternative specific constants (ASCs) are used, the estimates of the coefficient are biased, as they are likely to be correlated with the unobserved characteristics of the university. I do not focus my attention on the values of the alternative specific constants at the moment.

The formulation of the CNL-ASC model is similar to that of CNL model in that CNL a student *i* has a set of *J* universities to choose from. Each student's utility of choice is driven by his socio-economic background, university characteristics, other demographics, tuition fees and natural logarithm of distance to home/university, as shown in equation (2). The difference between CNL and CNL-ASC model is that the latter model includes alternative specific constants, δ_j, to address unobserved university characteristics, as shown in equation (6).

$$V_{ij} = \delta_j + \beta_2 X_j + (\beta_1 + \beta_3 Z_i) lndist_{ij} + \beta_4 X_j Z_i + \beta_5 lndist_{ij} X_j + \\ + \beta_6 (tuitionfees_{ij} * lndist_{ij}) \qquad (6)$$

The alternative specific constants are defined as the following:

$$\delta_j = \gamma X_j + \alpha \sigma_j + \xi_j \qquad (7)$$

where X_j is the observed characteristics of universities, in this case, a *RG* or *Top20* dummy, an *Ancient* dummy, a dummy for the region. The ξ_j are the unobserved attributes of university choice, which are assumed to be common across students attending university *j* e.g. the quality of university cafeteria. The only assumption that governs ξ_j is that it is the mean independent of observed university characteristics included in δ_j. σ_j is the percentage of the students (hereafter called "share"), out of the whole sample, who decided to study at university *j*. It is necessary for the BLP method. The shares are data derived and all add up to 1. The α coefficient is referred to in the literature as "taste coefficient" as its sign indicates whether there is a positive or negative preference towards a university. Moreover, there is endogeneity problem between the shares, σ_j, and with unobserved university attributes, ξ_j i.e. students may be choosing a particular university because of its cafeteria, a data point I do not observe. This correlation is dealt with during the estimation process of ASCs; however, it is a concern at the decomposition stage of ASCs and it can affect the sign of "taste coefficient", as well as of the other variables. Robust estimation method of "taste coefficient" and location characteristics can be found Bayer and Timmins (2007). Murdock and Timmins (2005) is an example of practical application of the method and the exposition in this paper is following theirs.

The estimation strategy is as follows. In the first step, δ_j is recovered by the contraction mapping method first developed by Berry (1994). The contraction mapping updates the values on the parameters until the predicted share equals the actual share, σ_j, which is calculated from the data. Specifically, first, as in typical CNL framework, the probability P_{ij} is calculated using the observed part of the utility, V_{ij}, as in equation (8). The additional component, the alternative constant, δ_j is included with an initial guess equal to 0. In equation (8)

$$P_{ij}^{m,q} = \frac{exp(V_{ij}^{m,q})}{\sum_{k=1}^{J} exp\left(V_{ik}^{m,q}\right)} \tag{8}$$

where m is the number of contraction mapping required to recover δ_j (the alternative-specific constants) and q is the number of iterations needed to recover the rest of the parameters The probabilities P_{ij} are estimated and then they are used to calculate the predicted shares $\hat{\sigma}_j^{m,q}$ as in equation (9).

$$\hat{\sigma}_j^{m,q} = \frac{1}{N}\sum_i P_{ij}^{mq} \tag{9}$$

Given the parameter vector $(\beta_1^p, \beta_2^p, \beta_3^p, \beta_4^p, \beta_5^p, \beta_6^p)$ with each contraction, the value of $\hat{\sigma}_j^{m,q}$ is being updated. Then, in order to calculate the δ_j, the estimated share $\hat{\sigma}_j^{m,q}$is subtracted from the data derived share σ_j as the equation (10) shows. The natural logarithms are due to mathematical derivations of the formula. For more details, see Berry (1994).

$$\delta_j^{m+1,q} = \delta_j^{m,q} + (ln\sigma_j - ln\hat{\sigma}_j^{m,q}) \tag{10}$$

Equation (10) requires one of the ASCs to be normalised to 0. When the estimated and the actual values of shares are equal, the estimated value of ASCs at contraction *m* becomes equal to the one in *m+1*, given a specified tolerance region, the alternative specific constants estimate, that is procedure continues up to *m* until the equation (10) is true.

Then, in the second step, the parameter vector $(\beta_1^p, \beta_2^p, \beta_3^p, \beta_4^p, \beta_5^p, \beta_6^p)$ and the vector of alternative-specific constants, which satisfies equation (10) are used to maximise the log likelihood function,

$$LL(\delta^{*q}, \beta_1^q, \beta_2^q, \beta_3^q, \beta_4^q, \beta_5^q, \beta_6^p | X, Z, lndist, tuitionfees) = \sum_{i=1}^{I}\sum_j y_{ij}\, lnP_{ij}^{*q} \tag{11}$$

where y_{ij}= 1 if student i chooses university j, and 0 otherwise. This gives the results for a conditional logit with alternative specific constants (CNL-ASC).[16]

Table 1.6

CONDITIONAL LOGIT ESTIMATION RESULTS

Individual Attribute	University Attribute	CNL(1)	CNL(2)
	SES interactions with Russell Group Dummy		
Professional	RG		Reference Cat
Manager	RG		-0.223*(0.012)
Admin	RG		-0.322*(0.018)
Skilled Trade	RG		-0.698*(0.019)
Other	RG		-0.898*(0.017)
No occupation	RG		-0.967*(0.016)
	SES interactions with distance		
Manager	Lndist	-0.013***(0.006)	-0.008(0.007)
Admin	Lndist	-0.037*(0.009)	-0.036*(0.009)
Skilled Trade	Lndist	-0.021**(0.009)	-0.040*(0.009)
Other	Lndist	-0.070*(0.007)	-0.082*(0.008)
No occupation	Lndist	-0.019*(0.007)	-0.044*(0.007)
Test Scores	Lndist		0.081*(0.025)
	Other interactions		
English	Lndist		-1.12*(0.009)
Welsh	Lndist		-0.639*(0.020)
Female	Lndist	0.471*(0.0048)	-0.0005(0.01)
	Lndist* RG		-0.003(0.005)
	Lndist * Tuition Fees		-0.054*(0.001)
	Russell	0.858*(0.004)	1.220*(0.008)
	Lndist	0.012(0.022)	1.043*(0.028)
Age	Lndist	-Yes*	Yes
Log likelihood		-1085465	-1077496
ρ^2		0.012	0.020

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first column represents students' attributes, the second column represents university attributes. When presented next to each other, they represent an interaction term. The exceptions are *lndist*RG* and *lndist*tuitionfees*, as both vary by university and are presented in same column

[16] Due to high computational costs and given a large sample size, choice size and parameter space all estimation is done in FORTRAN. For details on how the estimations are performed, see the Technical Appendix.

Table 1.7

CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS

Individual Attribute	University Attribute	CNL-ASC(1)	CNL-ASC(2)
	SES interactions with Russell Group Dummy		
Manager	RG		-0.224*(0.012)
Admin	RG		-0.322*(0.018)
Skilled Trade	RG		-0.698*(0.019)
Other	RG		-0.900*(0.017)
No occupation	RG		-0.969*(0.016)
	SES interactions with distance		
Manager	Lndist	-0.018*(0.004)	-0.007***(0.004)
Admin	Lndist	-0.055*(0.006)	-0.047*(0.006)
Skilled Trade	Lndist	-0.034*(0.005)	-0.046*(0.005)
Other	Lndist	-0.090*(0.005)	-0.955*(0.004)
No occupation	Lndist	-0.035*(0.004)	-0.533*(0.004)
Test Scores	Lndist		0.159*(0.013)
	Other interactions		
English	Lndist		-1.20*(0.004)
Welsh	Lndist		-0.715*(0.008)
Female	Lndist	-0.028*(0.002)	-0.029*(0.002)
	Lndist* RG		0.003(0.003)
	Lndist * Tuition Fees		-0.004*(0.001)
	Lndist	0.006 (0.013)	1.083*(0.007)
Age	Lndist	-Yes	Yes*
Log likelihood		-1017007	-1010311
ρ^2		0.075	0.081

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first column represents students' attributes, the second column represents university attributes. When presented next to each other, they represent an interaction term. The exceptions are *lndist*RG* and *lndist*tuitionfees* as both vary by university and are presented in same column. ASCs include RG dummy, Ancient dummy and region dummies, as well as data derived share.

1.6 Results

The results of the analysis can be found in Table 1.6 and Table 1.7, where in both, the first column represents individual specific characteristics and the second column holds the alternative specific variables. When characteristics are presented next to each other, they represent an interaction. The exceptions are *lndist*RG* and *lndist*tuitionfees*, which are interactions but are presented in one column as they are both alternative specific characteristics (ASC).

Overall, I estimated six models. The first model, CNL(1), is the simple conditional logit model including SES, gender, Russell Group dummy, and distance variables. The second model, CNL(2), is the extension of CNL(1) in that it includes the full set of explanatory variables and their interactions. In the third, CNL-ASC (1), and fourth, CNL-ASC(2), models, I estimate ASC logit models with and without the full set of variables. At the end of my analysis, I ran two additional models, CNL-ASC(3) and CNL-ASC(4) as sensitivity checks.

In CNL(1), the coefficient on distance is positive (0.012) and insignificant at the 5% level. The lack of significance in comparison with the Gibbons and Vignoles' (2012) study is potentially due to the fact that I include all socio-economic groups of students together, rather than calculating distance coefficient for each socio-economic group separately. It could also be because the full choice set is modelled. The insignificance implies that a male of "Professional" background, is indifferent, in choosing an institution, as to the home-university distance. The interactions of *lndist* and socio-economic variables are mostly significant in CNL(1) and CNL(2). Also, the directions of the interaction terms are mostly negative, as compared to the baseline category, the "Professional" group. It means utility from attending a university decreases with distance for

Table 1.8

SENSITIVITY CHECKS RESULTS CONDITIONAL LOGIT WITH ASCS

Individual Attributes	University Attribute	CNL-ASC(3)	CNL-ASC(4)
	SES interactions with Quality		
Manager	Quality	0.085*(0.015)	-0.189*(0.013)
Admin	Quality	0.142*(0.021)	-0.335*(0.019)
Skilled Trade	Quality	0.179*(0.021)	-0.728*(0.021)
Other	Quality	0.260*(0.017)	-0.960*(0.018)
No occupation	Quality	-0.050*(0.018)	-0.874*(0.017)
	SES interactions with distance		
Manager	Lndist	0.001 (0.0071)	-0.001 (0.0071)
Admin	Lndist	-0.035*(0.009)	-0.032*(0.009)
Skilled Trade	Lndist	-0.022*(0.009)	-0.021*(0.009)
Other	Lndist	-0.069**(0.008)	-0.070*(0.008)
No occupation	Lndist	-0.025*(0.007)	-0.031*(0.007)
Test scores	Lndist	0.161*(0.023)	0.165*(0.025)
	Other interactions		
English	Lndist	-1.211*(0.009)	-1.209*(0.01)
Welsh	Lndist	-0.725*(0.020)	-0.718*(0.020)
Female	Lndist	-0.030*(0.005)	-0.025*(0.005)
	Lndist*Quality	0.088*(0.007)	0.004(0.006)
	Lndist* Tuition Fees	-0.0044*(0.001)	-0.0049*(0.001)
	Lndist	1.050*(0.028)	1.035*(0.028)
Age		Yes	Yes***
Log likelihood		-1013038	-1010574
ρ^2		0.079	0.081

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The quality variable represents *Dummy* in CNL-ASC(3) and *Top20* in CNL-ASC(4). The first column represents students' attributes, the second column represents university attributes. When presented next to each other they represent an interaction term. The exceptions are *lndist*Quality* and *lndist*tuitionfees*, as both vary by university and are presented in same column. ASCs include *Dummy* dummy for CNL-ASC(3) and *Top20* dummy for ASCs in CNL-ASC(4). In both Ancient and region, dummies are also included, as well as data derived share.

students from lower socio-economic background in comparison to the highest group "Professional". The Russell Group dummy (*RG)* is also positive and significant in both models, implying that there is a positive utility derived from attending this group of universities. Finally, females are more likely to be positively affected by distance, as compared to men, as the coefficient on the interaction of female and distance is positive and significant.

Moving from CNL(1) to CNL(2), I observe improvement in model fit (around 10,000 log-likelihood units). This CNL(2) model is an extension of CNL(1) and additionally includes the Russell Group (*RG*) dummy interacted with distance and with the socio-economic group, as well as students' test scores, tuition fees and nationality, all interacted with *lndist*. The base utility, the coefficient on the *lndist* is positive (1.043) and significant at the 5% significance level. This is not surprising, as *lndist* represents now the results of Scottish males from "Professional" backgrounds. This implies that this group of students derives utility from moving away for their university. Interaction between test scores and distance is positive and significant, which implies that more able students are more likely to travel further away for their education. The interaction term on female and distance is negative but statistically insignificant at the 5% significance level. This interaction term changed sign from positive in CNL(1) to negative CNL(2), though it became insignificant. Another interesting result of CNL(2) is that Scottish students have, on average, lower disutility of distance, as seen from the negative and significant interaction terms on English and Welsh dummies and *lndist*. I cannot say that all Scottish students have a positive utility from distance because, although the coefficient on *lndist* is positive and significant, the other socio-economic groups of students (apart from the

“Managerial”) have negative interactions with distance. The interaction between *lndist* and tuition fees is negative and significant, which implies that the higher the tuition fees and distance, the less likely are students to choose a university. As for the interaction of Russell group (RG) with *lndist*, I observe a statistically insignificant effect, but the interaction terms between RG and socio-economic groups are negative and significant at the 5% significance level for all students groups. This means that they have a negative utility of attending Russell Group universities in comparison with the baseline *lndist*. This pattern repeats itself throughout the paper and the potential reason for this result requires further attention and is the reason why sensitivity checks are performed, as discussed below.

There are three potential interpretations of this negative coefficient of *SES*RG* in CNL(2) The straightforward explanation is that it may just be that these students have a higher disutility when RG universities are involved. More likely, this effect may reflect the fact that it is harder to get accepted into these universities and/or the relatively small size of these universities, which can make them seem less attractive as fewer student are able to attend them. I run sensitivity checks in order to make sure that this is not the case. Thirdly, the negative coefficients may reflect a lack of information or risk version for students from lower socio-economic backgrounds, which increase with distance for RG universities. The results for sensitivity checks are discussed below.

Moving from CNL(2) to CNL-ASC(1) and CNL-ASC(2) yields better model fits (log-likelihood values improve and ρ^2 increases). It confirms that CNL-ASC models are an improvement over simple conditional logit, and explain university choices better. As seen from Table 1.7, *lndist* is statistically insignificant in CNL-ASC(1), but significant and positive in my elaborate model, CNL-ASC(2). I also find a clearly negative statistically significant result for distance for all socio-economic groups in comparison with the baselines in both CNL-ASC(1) and CNL-ASC(2). In general, the coefficients on the *lndist*SES* interactions have the same sign in both ASC models. *manager*lndist* becomes significant at 10% in CNL-ASC(2) in comparison to CNL(2). Another result, which is similar to CNL(2) is that in CNL-ASC(2) the *RG* dummies interacted with the socio-economic groups have negative coefficients for all groups in comparison to the reference group. As in CNL(2), students with higher ability have a lower disutility of distance; however, the coefficient for females changes sign and becomes negative and significant in ASC-CNL(1) and ASC-CNL(2). The changes in sign of *female*lndist* and the gaining of significance of *manager*lndist* can be attributed to ASC model, which often affects the significance and the sign of the coefficient. It also suggests that "Manager" background students and females specifically, have an unobserved preference towards university choices, which are not accounted for with CNL models.

Finally, the results of CNL-ASC(2) also show similar patterns to CNL-ASC(1). They suggest that Scottish students indeed have a lower disutility of travel, as interaction of English and Welsh nationality is negative and significant.

The size of the effect is not very different from CNL(2). Interestingly, the interaction of the *RG* dummy with distance is positive but not significant, though it has changed sign in comparison to the CNL(2). A notable result is that in both CNL(2) and CNL-ASC (2), the sign of the interaction of tuition fees with distance is negative. Nonetheless, there is a big difference in the sizes, with CNL(2) at -0.054 and CNL-ASC(2) at -0.004, which suggests that fees have a negative effect on students' utility of university choice but using conditional logit might be overestimating the effect.

Table 1.8 presents the results from the sensitivity checks. To make sure I correctly interpret the coefficients for the *RG* dummies in CNL(2) and CNL-ASC(2), I generate a dummy variable, which I call *Dummy*, taking a value of 1 for randomly chosen non Russell Group university, and 0 for the rest of the universities. I make sure that the total number of students attending these *Dummy* universities is close to the number of students at the Russell Group universities. This is done to control for size of universities, where smaller universities may appear less attractive and drive the result to be negative. Then, I use *Dummy* instead of the *Russell Group* dummy in the model estimation. I also use an alternative university quality variable *Top20*, which indicates, whether an institution is listed in the ranking of top 20 in the UK. The resulting models are called CNL-ASC(3) and CNL-ASC(4). For ease of exposition, in Table 1.7 both variables are called *Quality*. They represent *Dummy* in CNL-ASC(3) and *Top20* CNL-ASC(4).

The results from CNL-ASC(3) show positive coefficients for the random *Dummy* interaction with socio-economic groups. This suggests that the negative coefficient cannot be attributed to the smaller size of the Russell Group universities, as I make sure the universities chosen for the *Dummy* are of similar sizes to those in the Russell Group. As the interaction *lndist*Dummy* is significant and positive, it suggests that students have positive utility from moving to these universities in comparison to Russell Group. CNL-ASC(4) results are very similar to those for the Russell Group dummy. On the one hand, it may imply that the negative coefficient on *SES*Top20* could be attributed to higher selectivity of those universities. Still, 17 out of the top 20 universities in the UK belong to the Russell Group. Although the higher entry requirements are likely to contribute to the negative utility of the Russell Group dummy, information constraints and risk aversion may contribute to the result. Finally, it may be possible that the social interaction argument may also be an explanation.

1.7 Conclusions

In this paper, I contributed to the literature by using a unique data set, which allowed me to perform a micro-analysis of students' university choice. The alternative specific constants method is an important improvement as it deals with unobserved university characteristics, which can potentially bias the estimation. This is emphasized by the change in results for females from positive to negative, and the change in the size of the effect for tuition fees interaction with distance. The inclusion of all the university alternatives in the UK in each estimation allows for full substitutability. At the same time, inclusion of all socio-economic groups together in each models permits comparison of results between groups.

The results suggest that Scottish students have, on average, a lower disutility of distance than their Welsh or English counterparts. This result, amongst many things, could be attributed to the fact that Scottish students have to pay the lowest fees. It means pricing higher education at £0 could have a significant effect on students' choices towards where they study, conditional on their participation. This result decreases in strength as socio-economic status of students changes, as all students but from the "Managerial" group have a negative interaction with distance. Also, I find that coefficients on *RG*SES* interactions are negative and statistically significant for all groups but the "Professional" one. It means that students from non-professional backgrounds have an increasing in distance disutility of attending Russell Group universities. This result could have important implications on *inter alia* labour market outcomes since higher wages can be attributed to students who graduate from these universities.

The issue of what is the best higher education policy is contentious to the public and policy makers. Following the previous discussion and the evidence presented in the literature review, some argue that due to high social returns, higher education should be subsidised. On the other hand, graduates enjoy private benefits of their education, such as higher wages than individuals without a university education. The results I present show that, unsurprisingly, students have a disutility of tuition fees-distance interaction. More importantly, I find that distance, which is treated as an approximation of the moving costs, varies between students with different socio-economic backgrounds. This result could have important policy implications. Students from lower SES backgrounds are subject to the same fees as all other students; however, they are less likely to move further away. In other words, they are more sensitive to moving costs. Up to now, I am not aware of any government support for students, based on where they want to study. This may have significant effects on students' decision about where to attend university. Students who are more sensitive to distance may actually have a smaller choice set of universities, if they are constrained by distance. The introduction of such support could potentially improve student mobility and therefore outcomes after graduation. Monetising moving costs per socio-economic group using Willingness to Pay is the focus of the next chapter.

Finally, although the results are an important improvement on previous research there are a few caveats in the research, which need to be pointed out. First, the students' application sets and ranking of their choices, as well as acceptances and rejections, are not known. It is also unlikely that all students consider all universities, as not all universities offer same subjects. For example, a student who wants to study medicine would have a different set of universities than a student who wants to study English. The choices are likely to be restricted by test scores, as well. Therefore, the next step in the research is designing an approximation of the application process. Some limitations of the model are contributed by the method used. Alternative specific constant logit cannot deal with Independence of Irrelevant Alternatives, which can lead to unrealistic substitution patterns. Also, it is not ideal to deal with heterogeneity of choice. One of the solutions to address heterogeneity of choices would have been estimating the models with random coefficient specification; however, due to the computational burden associated with the large sample size, this is left for future research.

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Chapter 2: Willingness to Pay for distance to university

2.1 Introduction

In this chapter, I investigate if distance to university can perpetuate undesirable socio-economic outcomes for students in the UK. I do so by calculating Willingness to Pay (WTP) for distance to university. I assume that distance to university is an approximation to moving costs and that distance is a relevant issue in education policy if students from "lower" socio-economic groups are more sensitive to moving costs to university than their counterparts from "higher" socio-economic backgrounds. Therefore, I want to test if students, controlling for demographics and test scores, value distance differently. The research question arises from the fact that students can choose to study anywhere in the UK, given they achieved sufficient grades at the end of high school; however, distance could be a deterrent[17], in that it may deter students whose (WTP) for distance to university is lower. As a result of variation in valuation of distance, these students are likely to be less willing to move to a more distant university.

[17] For a student from Edinburgh to study in London, to visit a family the cheapest round trip, using a bus, would costs about £52.00, but take up to 10 hours. Train takes only four and a half, but costs about £90 one way. Flying takes about the same time as train, if we include the requirement to be 2 hours before the flight, and it can cost around £45 one way. Taking the cheapest way of travel, if a student wants to visit his family four times a year, it will cost them £208. These costs are likely to be higher for students living in more remote areas with worse transport infrastructure. If we assume that a student lives on £500 per month, this is at least 10% of one month's income. Travel costs based on information found http://www.guardian.co.uk/flash/0,5860,632634,00.html

As the issue of inequalities is always on the agenda of the policy makers, understanding students' behaviour regarding university choices is a valuable contribution to the discussion of how to improve outcomes of students from lower socio-economic backgrounds. If distance is a deterrent, alternative policies could be designed to ensure that all students treat monetary costs of moving as equivalent, especially that there are no longer grants or loans in the UK to cover transport costs. Students who place a high price on distance may therefore be disadvantaged if they happen to live far away from a good university.

Some research has been dedicated to distance and university decision. Faggian *et al* (2007) (a) investigated the probabilities of acquiring education in Scotland (Wales) for Scottish (Welsh) students relative to studying in the rest of the UK by looking at cross border migration. A study which specifically accounts for distance in university participation and choice is that of Gibbons and Vignoles (2012). They focus on distance elasticities of university choice for different ethnic and socio-economic groups and find these vary between groups and, in general, students from lower backgrounds are more sensitive to distance.

The contributions of this study are the following. It contributes by taking into account both non-monetary and monetary reasons of moving to university of choice. The results from the estimation are used to calculate WTPs for distance to university, which monetise the decision of location of university. The WTP is calculated using coefficients on distance and income.

I use discrete-choice methods to model student university location decisions. A particular innovation is the use of alternative specific constants in the estimation framework to deal with bias caused by unobserved university attributes. It also ensures estimations of marginal utilities of income (MUIs) are unbiased. Additionally, I run separate estimation for each socio-economic group, which allows me to relax the assumption that unobservable university characteristics are the same for all socio-economic groups, which additionally ensure robust estimation of MUIs for each group. WTPs also ensure meaningful comparison of results between different models. Finally, another major contribution is generation of consideration choice set of universities for each student, which allows for approximation of true application process.

I apply the model to data from the Higher Education Statistics Agency (HESA). These data cover the entire population of graduates of UK universities. As universities are legally required to provide data to HESA, I can be certain that the data is nationally representative. The dataset includes information on the students' socio-economic background, an approximate measure of their test scores, age, nationality, income six months after graduation and postcode sector at the time of enrolment. I use the postcode information to calculate each student's distance to all universities. The dataset is extended to include information on universities and students' tuition fees.

The results indicate that students from the highest socio-economic background do not care about distance to university at all. The other socio-economic groups have a clear negative utility of distance. Results on WTPs show that a) students from the highest socio-economic background are not influenced negatively by distance in their university choice, at all; b) other students value distance differently depending on what attributes of universities are used in the models and at what distance the WTP is calculated c) when mean distance is used, students with lowest socio-economic status have the lowest WTP in the model with university quality and second lowest when the country of university is used.

The chapter is structured as follows. Section 2.2 has an overview of the literature, followed by section 2.3, which briefly discusses the tuition fees variable used. Section 2.4 describes the data. Section 2.5 presents in detail the income information used. The methods used are briefly discussed in 2.6, which also explains how WTPs and considerations sets are calculated. 2.7 presents the results and 2.8 discusses the caveats and potential further research points.

2.2 Literature Review

2.2.1 University choice literature

The effect of distance on individuals' university choice has been approached from three broad research perspectives. First, there is literature focussing on the modelling of university choice, which has been discussed in the previous chapter. Second, some of the university choice literature includes distance and focuses on (a) a decision to participate in university education and (b) the selection of an institution. These two choices are modelled jointly or separately. Regarding participation, Gibbons and Vignoles (2012) for the UK, and Frenette (2006) for Canada, show how distance affects participation of students. Gibbons and Vignoles (2012) find little or no effect on participation. On the other hand, Frenette (2006) shows students who live 'out of commuting distance' are less likely to attend university, with the effects being stronger for lower socio-economic groups. Also, Spiess and Wrohlich (2008) for Germany, and Sa *et al* (2006) for the Netherlands, show enrolment probability declines with distance. When it comes to the choice of university, Gibbons and Vignoles (2012) find that women are more affected by distance than men in their university choice; in contrast, Faggian *et al* (2007) (b) find women graduates are more mobile than men and that non-White students are less mobile after graduation. The caveat of their model is that they only look at cross border movement, which prevents them, for example, from taking account of the potentially large distance students' may have to travel to attend university in Scotland. On the other hand, Gibbons and Vignoles (2012) find some ethnic groups' elasticities of university choice with respect to distance are lower, while white men from "Professional" background are least sensitive to distance. At the same time, white men who receive free school meals are the most sensitive. Alm and Winters (2009), using a gravity model, model participation and location in the US state of Georgia. They find distance is an important determinant of participation, although the effect is significant for colleges but not for universities, where the former are considered lower quality. More importantly, they find that students choose, in general, the institution closest to them, regardless of whether it is a college or university, i.e. irrespective of institutional quality.

Finally, the research also relates to the migration literature although this mainly focusses on employment decisions rather than on choice of university. The migration literature provides relevant insights into how moving costs affect students' location decisions. Dustmann and Glitz (2011) provide an overview of migration issue related to education. They argue that the main reason why individuals decide to migrate is because they expect their lifetime income to be higher at the new destination. Distance will therefore not affect students' university decisions if students can maximise net discounted lifetime earnings by attending a particular university.

Some research has been dedicated to the issue of university choice from the point of view of migration. Faggian *et al* (2007)(a) study the migration behaviour of Scottish and Welsh students to university and after graduation. They find a relationship between mobility and human capital, i.e. higher human capital levels affect the propensity to migrate after graduation. Some courses, like medicine, are more likely to encourage migration behaviour as well; however, they find some difference between Scottish and Welsh students behaviour. At the same time, they point out that other factors, like social influences, could be affecting the results, although they are not able to control for it. Also, they use regional data in their model, i.e. they focus on students who stay in or leave Scotland or Wales. This overlooks within-country migration decisions.

2.2.2 Sampling of alternatives and consideration set literature

The assumption that students make their choices from a full set of universities is unlikely. Below I present literature which discusses the issues of decreasing the choices sets. First, the sampling of alternatives is an important extension in choice modelling literature when the size of the choice set may be prohibitively large. The most recent contribution, which also has an overview of the literature, comes from Ben-Akiva, Bierlaire and Frejinger (2009). They look at path selection for car journeys, where there are often multiple paths from origin to destination, and sampling of alternatives is necessary in order to estimate the model. The focus of their method is unbiased results rather than generation of actual choice set.

Another part of the literature focuses on consideration sets. It acknowledges that the decision making is a process, which occurs in stages and varies at each stage (Gensch 1987). Hauser and Wernerfelt (1990) discuss how consideration sets are generated through consumption of goods with the focus around decision costs. They also provide a useful overview of the consideration set literature. Gensch and Soofi (1995) point out that each individual at the beginning has an awareness set, which consists of all alternatives but some of them are more seriously considered in comparison to others. They propose an information-theoretic algorithm that identifies the consideration set, which consists of feasible choices. Their algorithm is based on attributes ratings and chosen alternatives. They find coefficients on consideration sets to be much smaller and not statistically significant in comparison to awareness sets.

Campbell *et al* (2014) look at the issue of consideration sets within the setting of willingness to pay in stated preference research. They point out that even in stated preference there is no reason to assume that all alternatives are considered. It is highly likely that individuals will only consider alternatives which are within their budget and/or are aligned with their preferences.

2.3 Tuition fees variation in the UK

Chapter 1 presented a detailed overview of the UK education system. This section is dedicated to the issue of variation in tuition fees and costs of studying. Table 2.1 presents the tuition fees over the sample. The fees vary by the individual's residency status and by the university, i.e. students' choice set of fees depends on where they are from, what year they enrol and in which country the institutions are located. The amounts in the table reflect the total costs of obtaining a degree and the years represent the year of enrolment. The years presented in the table include only enrolment years that overlap between the UK countries within the data used. The HESA data in this study includes graduates who graduated between 2006 and 2010 inclusive; however, their start dates will vary depending on the country of the institution. It means the dataset does not include the Scottish students who enrolled in 2002 and who were supposed to pay graduate endowment once they graduated. The graduate endowment was introduced in 2001 and required students who graduated to pay £2,000 ten months after graduation, which was 1st of April 2006. It is possible to assume that students in the study had anticipated paying graduate endowment. If this is a bias for the estimation, it is solved by including country dummies. The graduate endowment was abolished in 2007 and included students who graduated that year.

On the other hand, the last cohort of English students in the data enrolled in 2007, where it is 2006 for Scottish students. Therefore, those English students are also excluded from this analysis.

Table 2.1

TUITION FEES REQUIRED TO OBTAIN A DEGREE

Year	Scotland	England	Wales			
	Scottish students studying in:					
2003	£0	£0	£0			
2004	£0	£0	£0			
2005	£0	£0	£0			
2006	£0	£9000	£3600			
Year	Scotland	England	Wales	Scotland	England	Wales
	English/Northern Irish students studying in:			*Welsh students studying in:*		
2003	£4400	£3300	£3300	£2510	£1410	£1410
2004	£4500	£3375	£3375	£2610	£1485	£1485
2005	£4600	£3450	£3450	£2710	£1560	£3450
2006	£4700	£9000	£3525	£2810	£7110	£3525

Years refer to enrolment years. Numbers in the table represent the cost of the whole degree (three years in England and Wales, four in Scotland). Welsh tuition fee costs are net of the Welsh Government grant.

I will now focus on a few of possible examples to explain how the tuition fees worked over the time of the sample used in the study. A Scottish domicile student who enrolled at a Scottish university in 2003 would pay no tuition fees. The situation is the same if the said student decided to study anywhere in the UK as Table 2.1 shows. Enrolling in 2006, a Scottish domicile student would pay nothing for studying in Scotland, but he would have to pay £9000 to study in the rest of the UK (rUK). An English domicile student faces very different tuition fees both in 2003 and 2006. In 2003, an English student would have to pay £4400 to study in Scotland but £3300 to study in England. In 2006, these numbers are £4700 for Scotland and £9000 for England. Northern Irish students' situation is essentially the same as English. Welsh students receive a grant from the Welsh government, which makes studying at university a little less expensive than for English and Northern Irish students. They still have to pay £2810 to graduate from a university in Wales in 2006 in comparison to Scottish students paying £0.

2.4 The Data

2.4.1 General

There are a few general differences between the data in this and the previous study in Chapter 1. As students in the UK usually enrol between August and October, only students who enrolled within the "usual" administrative enrolment period are kept. Then, Scottish students who enrolled in 2002 and rUK students who enrolled in 2007 are excluded. This is because the data consists of students who graduated between 2006 and 2010. University degrees requires 3 years of study in England and 4 years in Scotland, the last year of our sample has overrepresentation of English students and it cannot be used i.e. the last English cohort in the data enrols in 2007 whereas the last Scottish cohort enrols in 2006. On the other hand, for year of enrolment 2002, it consists predominantly of Scottish students, as English students who graduate in 2006 would have enrolled in 2003; therefore 2002 is not taken into account either. A separate dummy variable will take into account potential crossing of water for Northern Irish. The two largest attrition groups came from: students who did not respond to the Destination of Leavers of Higher Education survey which holds the income information six months after graduation, and students whose socio economic class was unknown. The driving motive to exclude students whose socio economic class was "No occupation" is the estimation of MUIs. MUI for "No occupation" socio-economic group is unlikely to estimate without bias, as it potentially includes individuals from all socio-economic backgrounds.

As the largest attrition in the previous study has been due to missing test scores, a solution has been introduced in this paper. If students' test score information is missing it is approximated by average scores of students who attended the same university and graduated with the same degree. A detailed explanation of how this calculation is done is presented in section on generation of consideration sets. Finally, students' whose scores are below 100 are dropped from this sample, as it suggests unconventional admission and therefore maybe biasing the MUIs further.

2.4.2 Individual characteristics

First, students from Northern Ireland are included in this discussion. Also, as salary information for students is required, this chapter only considers students whose salary is known after they graduate. The sample size is under 130,000 for this study and the updated sample statistics are presented, though differences are very small, if any, between this and the introductory study and they are not statistically significant. The median student in the sample is 18 year of age, with the mean at 19, which is what we would expect as English students make up the majority and most English students would achieve university entrance qualifications at 18. Additionally, almost 59% of our students are female. The average test result is around 320. The median result is 330.

The distance descriptive statistics are calculated again, to see if there are large differences between chapters and to eliminate sample bias. The average distance travelled to university of choice is 141 km; however these averages vary by nationality and socio-economic group. English students travel on average 147 km to their university of choice. This distance drops substantially for Scottish and Welsh students to 75 km and 132km respectively. It would suggest that Scottish choose universities closer to home, or that they are less willing to move further away to study. Students whose parents are of “Professional” or “Managerial” background travel on average around 150km. “Administrative” and “Skilled Trade” background students moved around 130 km away from home. Finally, students whose parents have “Other” occupation travel on average 111 km. Also, on average women travel 21 km less than men.

2.4.3 University Characteristics

In the subsample, there are 126[18] institutions: 12 of which are in Wales, 17 in Scotland, 2 in the Northern Ireland, and the remainder located in England. I also include other university characteristics, like region (12 dummy variables), university ranking (Top20 dummy), whether the university is Ancient, and

[18] I find that in order to achieve meaningful results using alternative specific constants, at least 100 students per university is needed.

Table 2.2

INDIVIDUAL CHARACTERISTICS DESCRIPTIVE STATISTICS

	Mean	Std. Dev	Median	Min	Max
Descriptive statistics for the whole sample					
Test results	320	112	330	102	984
Age	19	4	18	16	65
Distance in km	141	182	81	0.05	1008
Distance travelled to universities of choice in km by SES					
Professional	150	176	96	0.05	1009
Manager	151	187	91	0.08	1010
Admin	134	181	73	0.05	983
Skilled trade	138	188	74	0.08	977
Other	111	174	45	0.08	983
Distance travelled to universities of choice in km by Nationality					
English	147	188	86	0.08	1009
Scottish	75	110	34	0.05	966
Welsh	132	152	81	0.38	840
Northern Irish	164	126	164	0.94	637
Distance by Gender					
Women	133	175	73	0.05	999
Men	154	193	92	0.07	1020

	Percentage
Demographic composition of total sample by Nationality	
England	87%
Scotland	7%
Wales	4%
Northern Irish	2%
Demographic composition of total sample by SES	
Professional	39%
Manager	23%
Admin	10%
Skilled trade	10%
Other	18%
Demographic composition of total sample by Gender	
Female	59%

Source: HESA Student Record 2009/10 Copyright Higher Education Statistics Agency Limited 2011. Age censored at 16 and 65 whether the university is part of the Russell Group (Russell Group dummy)[19]. Out of all students, 27% attend a Russell Group university and 26% attend a Top20 university.

2.5 Student incomes six months after graduation

The information about incomes and commonly available information about university application process is used to generate a variable used to calculate a marginal utility of income. The income information is known for some students six months after they graduate, through a survey called Destination of Leavers of Higher Education (DLHE), which is part of HESA, and these students are used in the analysis. The income used in the analysis is conditional of students' employment. In general, the (DLHE) sample is representative of the total HESA sample. The data on incomes comes banded, starting with £5000 or under. The following bands are increasing increments of £5000. The last band is £100,001 or above. For calculation of marginal utilities, actual incomes are needed rather than categorical variables. Therefore, for each individual whose income is known I assume his actual income is the middle value of the band. For example, if someone earns between £15,001 and £20,000 I assume they actually earn £17,501. As the bands are small, I do not expect this approximation to cause bias. Incomes are then averaged per university and per subject and they are substituted into the alternative choices, which are drawn in a random draw, with the actual

[19] Prestige organisations, similar to the Ivy League in USA, which includes most of the best UK universities.

income used for the university of choice, where students' draws are constraint by their subject of graduation and their test scores. This way, the counterfactual is approximated. From the observed data, the average income for students after graduation is £18,371 with maximum income at £28,428 for biological sciences graduates and £15,077 for creative arts and design students. The magnitudes are plausible. Since I know students' occupations as well as incomes, I check if students are underemployed i.e. if a medical student works as a waiter etc. I do not do an exact occupational match. Rather, I check how many students are working in occupations, which I deem do not require a university degree. In practice, it includes anyone whose occupational code was above a certain level[20]. This is the case for 10% of students whose wages are known. This increases to 17% if only occupation after graduation is taken into account. This could bias my results on MUIs. The issue of wages after graduation raises the question of job matching and sorting, which are not in the scope of this study.

The issue of underemployment means that six months after their graduation, some students are in positions for which they are overeducated. Over-education itself attracts considerable attention and thorough consideration of it is beyond the scope of this paper; however, I will discuss problems, which relate to this study. The detailed overview of the literature and the pertaining issues can be found in Leuven and Oosterbeek (2011). The first issue related to over-education is its measurement. The way it is presented in this paper is a very simple one but it

[20] The exact occupational coding used was above 62111 where the coding is provided by Standard Occupational Classification 5 digit. 62111 is the code for museum assistants where 62112 is the code for bookmakers. Codes increase in decreasing skill requirement.

is based on a measurement build on job requirements and job analysis using occupational codes. The other two are based on workers self-assessment and realised match, where whether a worker is over-schooled or under-schooled is calculated based on the average schooling of all workers in a particular occupation. This method of calculating over-education has been criticized as over-schooling is not synonymous with being over-skilled. Chevalier (2003) pointed out that not all graduates have the same ability.

In comparison to other studies concerned with over-education summarized by Leuven and Oosterbeek (2011), which are focused on over-education, the proportion of over-schooling presented in this study is way below the averages. One of the reasons for this may be that I only deal with university graduates.

Finally, it is important to point out that students' who could be considered overeducated, do not have to stay in occupations which are below their education levels. Some students may be willing to start in positions below their education level due to future prospects for promotion (Sicherman and Galor, 1990). This implies dynamics in the issue of over-education, which I cannot address using the present data.

2.6 Methods and Model

The model used is the same as in Chapter 1 and it is the conditional logit with alternative specific constants (CNL-ASC). Therefore, it is only briefly presented here; however, in this model I introduce consideration sets. I explain how they are generated in the following paragraph. I then very briefly go over the logit model.

2.6.1 Generation of consideration set

A large contribution of this paper, which has not been attempted before in this context, is the generation of approximate, actual choice sets. The benefits to decreasing the choice set are as follows; it allows the creation of a believable choice set and it approximates the actual application process.

Let's imagine a student, close to graduating from high school, who wants to study medicine. Even before he looks at the university choices, he constrains his choice set to only universities, which offer medicine. Then, he may or may not have constrained his choice again given his test scores. He has to bind his choice with a set number. It is because the application process is centralised in the UK through Universities and Colleges Admission Services, which has a ceiling for the number of university applications made. It has changed over the years, and is different for some courses, but for the time of the sample used in the study it was six[21].

The exact process of the consideration set generation is as follows. First each student's choice set is constrained by the subject in which he graduated. For each subject and each university, an approximation of entry requirements is generated. The entry requirements are generated by calculating an average per

[21] It is five for student enrolling in 2015, with medicine, veterinary studies and dentistry constrained at four.

each subject per university minus one standard deviation. This is also used to input missing test score information for some students, which is the case for about three quarters of the sample. Finally, the student's choice set consists of his university of graduation and randomly drawn up to five other universities as long as his test scores are at least equal to the entry requirement. This method allows for the students choice set to be anything from one to six, varying on their test scores and subjects. The main caveat of the method is that it does not take into account the potential that some students might have actually chosen to study more than one subject. This is a data constraint, which at the moment cannot be addressed.

2.6.2 The Conditional Logit with Alternative Specific Constants

The model is based on Berry *et al* (1995) and it starts with typical conditional logit assumptions that a student *i* has a set of universities J to choose from. Each student's utility of choice is driven by his socio-economic background, university characteristics, other demographics, income, fees and distance to university. The model allows the estimation of the (dis)utility of distance, marginal utilities of income and observed university characteristics as well as interactions of individual characteristics with the distance.

Students' utility is presented in equations (1) and (2).[22]

[22] The framework I present below follows that of Murdock and Timmins (2007).

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

$$V_{ij} = \delta_j + \beta_1 X_j + (\beta_0 + \beta_2 Z_i) lndist_{ij} + \beta_3 X_j Z_i + \beta_4 lndist_{ij} X_j + \beta_5 tuitionfees_{ij} + \beta_6 Y_{ij} \tag{2}$$

$$\delta_j = \gamma X_j + \alpha \sigma_j + \xi_j \tag{3}$$

where V_{ij} is the observed component of utility U_{ij}, which consists of the natural logarithm of distance for each student i to university *j*, $lndist_{ij}$. X_j are the observed characteristics of university *j*: *Top20* dummy, *Ancient* dummy and regional dummies. Z_i are the observed characteristics of individual i, socio-economic class, age, gender or test scores. ε_{ij} is the random utility component. $tuitionfees_{ij}$ are the fees a student would pay for studying at a university *j* given his residency status, Y_{ij} is the student income given the university of choice j. The monetary terms are divided by 10,000 to bring the magnitudes to similar scale. The interaction terms allow to identify how observed individual characteristics affect the utility of choice. The typical logit model has been extended by δ_j, which are the alternative- specific constants. Equation (3) shows the decomposition of the alternative-specific constants. It includes: the observed characteristics of universities X_j, which apart from the ones included in the equation 2 also include dummies for region and whether the university is Ancient. ξ_j is the unobservable attribute of university choice, which is assumed to be common across a group of students who study at university *j*, and σ_j is the percentage of students, out of the group, who decided to study at university j. In the rest of the paper, for simplicity, it is called it the share. It is data derived.

The estimation strategy has been discussed in detail in the previous chapter and here it is just a reminder. In the first stage, we recover δ_j by the contraction mapping method first developed by Berry (1994). The contraction mapping updates the values on the parameters until the predicted share equals the actual share, which is calculated from the data.

$$P_{ij}^{m,q} = \frac{exp(V_{ij}^{m,q})}{\sum_{j=1}^{k} exp(V_{ik}^{m,q})} \tag{4}$$

In order to estimate the predicted share $\hat{\sigma}_j^{m,q}$, where m is the number of contraction required to recover δ_j (the alternative-specific constants) and q is the number of iterations needed to recover the rest of the parameters, the probabilities given in equation (4) are estimated. Then, the predicted share of students who choose a specific university is equal to

$$\hat{\sigma}_j^{m,q} = \frac{1}{N} \sum_i P_{ij}^{mq} \tag{5}$$

Finally, given the parameters estimated in equation (5) the contraction mapping iterates the following function

$$\delta_j^{m+1,q} = \delta_j^{m,q} + (ln\sigma_j - ln\hat{\sigma}_j^{m,q}) \tag{6}$$

until a vector of δ_j is recovered, which equalises the predicted shares to the actual shares σ_j (see Berry *et al* (1995) for the proof).

In the second stage of the estimation, I use the parameters and the alternative-specific constants from the contraction mapping to maximise the log likelihood function

$$\text{LL}(\delta^{*q}, \beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 \mid X, Z, dist) = \sum_{i=1}^{I} \sum_j y_{ij} \, lnP_{ij}^* \qquad (7)$$

In simple terms, the model introduces university-specific constants, which deal with unobserved university characteristics.

To calculate the willingness to pay (WTP) for distance, the disutility of the log of distance, β_0 is used. Two sets of results for WTP are presented. One set has the marginal utility of income, β_6, as the denominator. These results can be found in tables 2.3 (b) and 2.4.(b). The other set uses β_5 marginal disutility of tuition fees can be found in 2.3.(c) and 2.4.(c). WTP is the maximum amount an individual is willing to sacrifice to procure a good education or avoid something undesirable and it is calculated in the following way for this study:

WTP using tuition fees coefficient

$$WTP_g = (-)\,\frac{\beta_0}{\beta_5} * \frac{1}{distance} \qquad (8)$$

WTP using income coefficient

$$WTP_g = (-)\,\frac{\beta_0}{\beta_6} * \frac{1}{distance} \qquad (9)$$

where g represents a socio-economic group. The additional element of $\frac{1}{distance}$ results from the fact that distance coefficients are estimated using a natural log of distance. The negative sign in the brackets allows for potential differences distance can have on an individual’s utility i.e. positive or negative. The interpretation of the values of the WTP is following: let’s first imagine instead of distance to universities, it is a distance to an amenity in a neighbourhood, like a gym, and the potential for physical exercise. The value of WTP presents how much a group would be willing to pay to have a gym closer, i.e. how much does this group care about going to the gym. In the same way, the values presented show how much extra a socio-economic group would be willing pay to have a university one kilometre closer to home, i.e. how much they value university. The values are presented both using the costs, tuition fees or membership fees, and the benefits, like getting a degree or physically fitter. The results are similar when using both costs and benefits of university education. This gives assurance that coefficients are correctly estimated.

2.7 Results

Table 2.3 a

ESTIMATION RESULTS – CNL-ASC(1)

TOP20

Model	Lndist		Income		Fees		LL
Professional	0.001	(0.003)	1.147	(0.012)	-1.422	(0.065)	-1.1544
Manager	-0.067	(0.005)	0.723	(0.014)	-1.487	(0.084)	-1.3096
Skilled trade + Admin	-0.061	(0.007)	1.060	(0.017)	-1.252	(0.076)	-1.3151
Other	-0.045	(0.007)	0.930	(0.017)	-1.578	(0.072)	-1.3627
All together	-0.081	(0.009)	0.209	(0.007)	-1.247	(0.032)	-1.3230

All results are significant at 1% apart from *lndist* in the Professional model, which is insignificant.

The column LL contains log likelihood normalised by the number of observations.

All together indicates the results of a regression, where all socio-economic groups are together, with dummies for socio-economic groups, with the Professional socio-economic group being the reference group. All models also includes: tuition fees, interactions of *lndist* with age and dummies for female and Top20, with Top20 dummy interacted with *lndist* and on its own. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Table 2.4 a

ESTIMATION RESULTS – CNL-ASC(2)

COUNTRY

Model	Lndist		Income		Fees		LL
Professional	0.650	(0.024)	0.873	(0.012)	-0.482	0.060	- 1.1735
Manager	-0.016	(0.001)	0.721	(0.014)	-1.469	0.079	-1.3101
Skilled trade + Admin	-0.105	(0.025)	1.068	(0.016)	-1.355	0.080	- 1.3151
Other	-0.043	(0.004)	0.931	(0.017)	-1.561	0.076	- 1.3626
All together	-0.081	(0.009)	0.209	(0.007)	-1.246	0.032	- 1.3230

All results are significant at 1%.

The column LL contains log likelihood normalised by the number of observations

All together indicates the results of a regression, where all socio-economic groups are together, with dummies for socio-economic groups, with Professional socio-economic group being the reference group. All models also include: tuition, and the country of institution with English institutions being the reference group interactions as well as interactions of lndist with age and female. ASCs include RG dummy, Ancient dummy and region dummies, as well as data derived share.

2.7.1 Estimation results

The following section contains the results of the analysis. The information about the estimations results can found in Table 2.3a and Table 2.4a. The first model, CNL-ASC(1), includes the university quality measure, *Top20*. The second model, CNL-ASC(2), contains information about the country the institution is located in: England, Scotland, Wales or Northern Ireland. English universities are the reference groups. In both tables, for ease of exposition most coefficients are suppressed, as the focus is on the coefficient on distance *lndist*, *income* and *fees*. Full results, including estimation statistics, can be found in Appendix 2.A. For each specification, I run a model with all socio-economic groups together as dummies and then I run same specification separately for each socio-economic group, where no socio-economic dummies are present. All specifications include tuition fees, income, the log of distance *lndist* and the interactions of *lndist* with student's age and dummy for female students. Also, all specifications include the choice restriction to a consideration set. If the specifications are estimated with all socio-economic groups together, the model also includes SES interactions with distance variable. As the sample size is halved in comparison with the previous study for meaningful estimation of MUIs, I combine "Skilled Trade" and "Administrative" students.

Table 2.3a presents the results of model CNL-ASC(1), with the first row containing results for this specification, but the model only includes students from the "Professional" background, the row entitled "Manager" includes CNL-ASC(1) estimated only on students from the "Manager" background, and so and so forth.

The row entitled “All together” includes estimation results when all SES are together. I find that “Professional” students do not care about *lndist*, i.e. the coefficient is not statistically significant and positive. This result is important especially with comparison to a specification where all socio-economic are “All together”, where it is negative, and statistically significant. The coefficient of *lndist* is also negative and significant for the other three models, when the specifications are run separately, and though in discrete choice comparison between coefficient is difficult the coefficients stay similar sizes between -0.47 to -0.67. The coefficients on *income* are all positive and significant at 1%. The coefficient is the largest on “All together” and stands at 1.359 and it is the lowest for “Manager” at 0.723. The other three models have *income* coefficients close to 1. Fees results are all over 1, with “All together” being the largest at -1.247 and “Other” being the smallest at -1.578.

Results for the second specification, CNL-ASC(2) are presented in Table 2.4a, which excludes approximation of university quality but includes country dummies instead, with English universities being the reference group. The results in the table are presented the same way as in the previous specification. The results on *lndist* vary between groups. “Professional” background students have a positive and significant coefficient on *lndist*, which stands at 0.65. Their income coefficient is positive and statistically significant at 1% and is equal to 0.873. The coefficients on incomes in other models are also all statistically significant and positive. The *income* coefficient is the lowest for “All Together” model at 0.209. It is 0.721 for “Manager” model, 1.068 for “Skilled Trade and Admin” and 0,931 for “Other. The coefficients on the distance vary. They range from -0.016 for “Manager”, -0.105 for “Skilled Trade and Admin” and -0.043 for “Other”. They continue to be statistically significant.

Fees results are -1.246 for “All together”. All results but “Professional” are similar, with “Other” being the smallest at -1.561. The coefficient is much larger for “Professional” at -0.482.

It is important to point out that for both specifications *lndist* has a slightly different interpretation. Going back to the gym example I still look at the distance to the gym but then look at for how distance is important and gyms opening hours, or if it offers crèche facilities. These variables will have different interactions (meant in the non-mathematical sense of the word) with the distance and affect different people’s utility of distance to the gym different. So, in CNL-ASC(1) it measures the utility of distance to non-*Top20* university where in CNL-ASC(2) it holds information about the utility of distance to *English* universities.

2.7.2 Willingness to Pay

For both specifications, CNL-ASC(1) and CNL-ASC(2) and each model ran, I calculate WTP on the results from coefficients of *lndist, income* and *tuitionfees.* The results are presented in Table 2.3b and 2.3c for CNL-ASC(1) and in Table 2.4b and 2.4c for CNL-ASC(2). They are in Pounds Sterling. To achieve the numbers in the table, the WTPs are multiplied by 10,000, as the monetary terms were divided by 10,000 for estimation purposes. For comparison, I calculate it at different distances, which are presented in Table 2.2 with descriptive statistics.

Column (1) to (3) in Table 2.3b, (6) to (8) in Table 2.4b, (11) to (13) in Table 2.3c and (16)-(18) in Table 2.4c provide information on WTP at mean (140 km), median (81km) and maximum (1080km) distance respectively calculated with all socio-economic groups together in the sample. Columns (4), (5), (9), (10), (14), (15), (19) and (20) have WTPs at mean and median distances respectively, calculated separately for each group

Column (1) in Table 2.3.b has WTP calculated at mean distance. I do not include results for the "Professional" model as the *lndist* result is not significant. The results for the other four models are in the expected order i.e. "Manager" has the highest WTP at £6.62 per mean distance to university. It is £4.11 for "Skilled Trade and Admin" and £3.46 for "Other". A similar pattern follows for WTP calculated at median and maximum. WTPs for "All together" are close to an average for each three WTPs and are £4.26, £7.36 and £0.58 respectively. There are two important conclusions from this discussion a) students from the highest background have the highest WTP for distance to university b) calculating the WTP per socio-economic group is necessary as the results on WTP when all SES are together tend to over or under estimate the WTPs. Columns (4) and (5) have WTPs calculated at mean and median, respectively, with each mean and median calculated separately for each group, i.e. each WTP estimation has a different distance used in these two columns. For means, it is 150 km for "Manager", 136 km for "Skilled Trade and Admin" and 111 km for "Other". The "Manager" model has the highest WTP with the highest mean distance, at £6.18. It is around £4 for the other two groups, but it is important to point out the different distances these groups travel on average. On the other hand, these values are similar to those when WTP is calculated on the mean for the whole sample. Column (5) presents results for median distance where median distance travelled 91km for “Manager”, 73km for “Skilled Trade and Admin” and 43km for “Other”. In here, “Other” have the highest WTP at £10.75 but their median distance is half of “Manager” whose WTP is £10.18. “Skilled Trade and Admin” stands at £7.88. The results suggest that WTP for distance to university is not linear. It is the case for all socio-economic groups, but the effect is the greatest for the lowest socio-economic group, i.e. their WTP is much higher at the lower distances in comparison to greater distances. This is especially noticeable when WTPs are compared between the group’s mean and median, columns (4) and (5). Finally, this is a WTP for distance to universities, which are out of the Top20 rankings.

Table 2.3 b

WILLINGNESS TO PAY RESULTS – CNL-ASC(1)- INCOME TOP20

	(1)	(2)	(3)	(4)	(5)
	Mean	Median	Max	Mean	Median
Professional	-	-	-	-	-
Manager	6.62	11.44	0.91	6.18	10.18
Skilled trade + Admin	4.11	7.10	0.56	4.23	7.88
Other	3.46	5.97	0.47	4.36	10.75
All together	27.68	47.85	3.80		

Columns 1-3 contain information for distance descriptive statistics calculated for the whole sample. Columns 4 and 5 contain WTP for distance descriptive statistics calculated per SES.
WTP in Pounds Sterling. All WTPs are statistically significant at 5% significance. T-ratios calculated using delta method.

Table 2.4 b

WILLINGNESS TO PAY RESULTS - CNL-ASC(2) – INCOME COUNTRY

	(6)	(7)	(8)	(9)	(10)
	mean	median	Max	Mean	Median
Professional	-	-	-	-	-
Manager	1.59	2.74	0.22	1.48	2.44
Skilled trade + Admin	7.02	12.13	0.96	7.22	13.46
Other	3.30	5.71	0.45	4.16	10.27
All together	27.69	47.86	3.80		

Columns 6-8 contain information for distance descriptive statistics calculated for the whole sample. Columns 9 and 10 contain information for distance descriptive statistics calculated per SES.
WTP in Pounds Sterling. All WTPs are statistically significant at 5% significance. T-ratios calculated using delta method.

The WTPs for CNL-ASC(2) are presented in in Table 2.4b. They are all significant. Again, results for "Professional" are not presented as they seem to derive utility from distance. All five measures of WTP have a similar pattern with "Skilled Trade and Admin" having the highest WTP, "Other" having second highest, though considerably smaller, with "Manager" having the lowest WTP. WTPs for "All together" are much larger than the ones calculated separately for each model, in all three possible cases. For example, at mean distance WTP found in column (6) WTP is £27.69 for coefficients calculated "All together" when the second highest "Other" is £7.02. This reaffirms the importance of calculating them separately for each SES. The results suggest that "Skilled Trade and Admin" background students are the ones with the highest WTP when it comes to distance to an English university.

Table 2.3 c

WILLINGNESS TO PAY RESULTS – CNL-ASC(1) – FEES

TOP20

	(11)	(12)	(13)	(14)	(15)
	mean	median	Max	Mean	Median
Professional	-	-	-	-	-
Manager	3.23	5.59	0.44	3.02	4.97
Skilled trade + Admin	3.49	6.02	0.48	3.59	6.64
Other	2.05	3.54	0.28	2.58	6.37
All together	2.80	4.84	0.38		

Columns 11-13 contain information for distance descriptive statistics calculated for the whole sample. Columns 14 and 15 contain WTP for distance descriptive statistics calculated per SES.
WTP in Pounds Sterling. All WTPs are statistically significant at 5% significance. T-ratios calculated using delta method.

Table 2.4 c

WILLINGNESS TO PAY RESULTS - CNL-ASC(2) – FEES

COUNTRY

	(16)	(17)	(18)	(19)	(20)
	mean	median	Max	Mean	Median
Professional	-	-	-	-	-
Manager	0.78	1.34	0.11	0.73	1.20
Skilled trade + Admin	5.54	9.57	0.76	5.17	8.52
Other	1.97	3.40	0.27	1.84	3.03
All together	4.66	8.06	0.64		

Columns 16-18 contain information for distance descriptive statistics calculated for the whole sample. Columns 19 and 20 contain information for distance descriptive statistics calculated per SES.
WTP in Pounds Sterling. All WTPs are statistically significant at 5% significance. T-ratios calculated using delta method.

The results where tuition fees are used to calculate the WTP for distance are presented in Table 2.3c and Table 2.4c. The results for CNL-ASC(1), where Top20 is used, follow similar pattern to that where income is used, though there are two differences which need pointing out. First, the WTPs on “All together” are much more similar in size to the rest of WTPs. This is not surprising, as students, irrespective of their socio-economic class, face similar costs, but it also means, looking at previous set of results, that their benefits, i.e. graduate incomes, vary significantly more. In this case, the WTP is the highest for “Skilled trade and admin” throughout. This is true, both for CNL-ASC(1) and CNL-ASC(2). The WTPs in both table 2.3c and 2.4c are the largest for median calculated for each group separately. This suggests that for lower SES students, commutable distance increases the value of the university, i.e. having a university closer, when it is already within a commutable distance carries more value for these students, than when the university is already far away.

The above WTP results for both specifications have to be considered in view of the specifications used. The *lndist* in CNL-ASC(1) measures amongst other things the utility of distance to a non-Top20 university, where in CNL-ASC(2) it is the utility of distance to an English university. Therefore, the above results suggest the WTP decreases with SES when non-Top20 universities are included, apart from “Professional” who do not get any utility from distance to a non-Top20 university. On the other hand, lower SES students have a higher WTP for distance to an English university.

2.8 Conclusions

This paper contributes to the literature of students’ university choice by monetising the decision to move. The study also contributes by including a new method of approximation of students’ choice process. The method allowed for constraining the choice to a more believable size but more importantly, in comparison with previous studies, which constrain choices, it still produced statistically significant results. Finally, estimating WTP separately for each socio-economic group allowed for a) variation in the unobservable university characteristics between socio-economic groups b) calculation of group-specific WTPs, which are true to size and c) meaningful comparison between groups.

The results show that costs vary between socio-economic groups with students from lower socio-economic background having on average the highest WTP for distance to university, though the result suggest it is important which university characteristic is in question. Their WTP for distance is generally lower when non-Top20 (CNL-ASC(1)) universities are involved but at the same time they have a higher WTP for distance to for English universities (CNL-ASC(2)).

From a policy design perspective, the above results do not present a clear solution. For top SES "Professional", distance to university does not appear to be an issue. The results for the other SES are mixed and they suggest different university characteristics can have different effects on different SESs and that disutility of distance is non-linear. On the other hand, some of the variation in the results on WTPs may be because SES is only an approximation of income and e.g. "Manager" SES encompassing a wide range of managerial positions. A further extension would be to use detail Standard Occupational Classification information to generate groups whose incomes are more uniform. Also, different specification could be attempted to see if the WTPs will be different when different measure of university quality is used or if Scottish universities are the reference group. Finally, WTP for quality of university and other university characteristics is another possible extension. Using more robust estimation strategies, like random coefficients methods, could additionally produce better results.

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Chapter 3: Future income discount rate of students

3.1 Introduction

This chapter informs the discussion on students' university choice through investigating their attitudes towards university tuition fees and subsequent earnings as part of the university choice process. It does this by estimating students' discount rate of future income using the marginal utility of income (MUI) of tuition fees and wages after their graduation.

This chapter contributes to two discussions regarding students' university choice. First, by estimating the discount rates, it elicits students' revealed income attitudes towards costs and benefits of studying. It contributes towards ongoing discussion of university tuition fees. It is generally assumed that students do not like tuition fees and are always against increases[23]. This paper investigates this and informs the discussion on investment behaviour of students and explores how tuition fees could affect their choice behaviour[24]. Secondly, by investigating discount rates this paper considers the importance of future earnings to students as one of the determinants of their university choice. This, in turn, aims to inform the higher education policy about the best way to improve outcomes for students, in

[23] For an example of student demonstrations against an increase in tuition fees see http://www.bbc.co.uk/news/education-15646709

[24] Investment can be understood in financial terms, as well as, time or psychic strain of studying.

particular for those from lower socio-economic backgrounds. The paper investigates these issues using the UK as an example.

Another contribution of this paper is that it fills an important gap in university choice literature by investigating students' discount rates of future incomes, which has been overlooked in the literature.

The analysis used in the paper focuses on testing the hypothesis that students' negative reactions to university fees may be due to the overestimated value of tuition fees. As this paper is built around students' university choice, conditional logit (McFadden 1974) with alternative specific constants (CNL-ASC) is used as the modelling framework. CNL-ASC deals with unobserved characteristics of universities, which can be correlated with the coefficients and therefore result in biased estimates. Therefore, this paper provides a robust identification strategy of marginal utilities of income.

The data used in the paper is provided by Higher Education Statistical Agency (HESA) and contains the whole population of students who enrolled in the UK universities. All universities are legally obliged to report the information on students to HESA, which gives the confidence that the dataset contains the whole student population. As in previous chapters, this dataset is extended with university specific information. In this paper, the sample of students for whom income is available is used in the estimation. This information is found in Destination of Leavers of Higher Education, which is a survey attached to HESA. It holds information on students' wages for six months after their graduation.

The results on MUIs are extremely stable across different specifications used, which confirms the robustness of the identification strategy. The discount rates of students suggest that students are rational regarding their university choice decision when the full set of university choices is used. When consideration sets are used, the discounts rates become negative in most models estimated. This suggests that students in general overestimate their future incomes.

The paper has the following structure. Section 2 gives background information on the issues of discounting the future and related university choice literature. Section 3 briefly discusses differences in tuition fees across the UK. Section 4 introduces the data. Section 5 investigates how changes in funding systems affect university choice by comparing the enrolment between the UK countries before and after the change in tuition fees. Section 6 elaborates on information on potential expected student earnings in the UK, using discounted graduate earning and how these would be affected by changes in tuition fees. Section 7 discusses in more detail the identification strategy for estimation of MUIs. Section 8 presents the method used; and Section 9 provides the results of the estimation. The final section concludes and discusses potential future research.

3.2. Literature review

Changes to tuition fees attract the attention of both economists and policy makers. The focus in the UK has been predominantly on the effect of tuition fees on participation rather than university choice; see e.g., House of Commons Public Accounts Committee "Widening Participation in Higher Education" (House of Commons 226) for an overview in participation patterns. The general worry is that increases will have a negative effect on students whereas decreases will have a positive effect; however, Denny (2014) presents a study on the abolition of tuition fees in Ireland and he shows that it had no positive effect on participation of students from lower socio-economic backgrounds. At the same time, the introduction of tuition fees in the UK has not had a negative effect on participation of low-income students, whose participation has an increasing trend since 1998 (Dearden *et al* 2011). Both of these results are likely to affect policy design. Below, I present literature which provides overview of issues pertaining to the topic of why manipulating the tuition fees does not always produce expected results.

3.2.1. Perceived returns to higher education

A number of studies have been dedicated to showing that students' perceived returns to schooling are not in line with the human capital theory (Becker 1964). In the view of Becker's theory, a student's cost-benefit analysis should compare the tuition fees and forgone earnings with future discounted wages; however, it has been noted that it is the perceived returns that matter in the decision making process. Manski (1993) points out students' perceived returns are not known and researchers often do not know on what they are based. More recently, information constraints regarding returns have been blamed for discrepancies between observed and perceived returns. Nguyen (2008) Jansen (2010), through experimental studies, show how school students from poor backgrounds can update their behaviour if they are made aware of the true returns of schooling. Jansen (2010) also shows that poor students perceived returns of schooling are much lower than the actual ones. More recently, McGuigan *et al* (2012) show the importance of correct information about returns to higher education in the UK in the decision to participate in higher education. They show through an experiment, that if high school students are not well informed about the benefits of university education, increases in tuition fees will be met with reluctance. The issue of perceived returns has not been studied in the context of university choice but the issues raised by the participation literature can be easily extended to that of choice of university.

3.2.2. Higher education as consumption good

Information constraints may not be the only reason why students' behave in a way that would suggest university participation does not maximise their monetary returns. Some attention has been given to university education as a consumed good. Lazear (1977) distinguishes between education as a consumed good and income increasing asset. He finds that education is a "bad" and most individuals apart from the ones who study at least 18 years "consume" suboptimal levels of education for their wealth maximisation. Alstadsaeter (2011) investigates how course choices are affected by consumption value of these courses and how, in general, consumption values can be an important factor in degree type decision making.

3.2.3. Inconsistencies in choice optimisation

Literature regarding inconsistencies in choice optimisation concerning other aspects of life, suggests alternative potential reasons for suboptimal choices of universities, i.e. individuals often miscalculate costs and benefits. Allcott and Wozny (2011) show consumers choose cars with suboptimal fuel efficiency; i.e., consumers undervalue the future savings from vehicles that use less fuel. Abaluck and Gruber (2011) analyse the choices the elderly make regarding their health insurance plans, and they find elders put more weight on premiums than out-of-pocket costs. Extending it to the issue of students' university choice, one can say a) students underestimate university choices' effect on their future incomes b) overestimate the value of tuition fees.

I believe I find a gap in the literature in looking at students tuition fees and future income trade-offs, through calculating their discount rates.

3.3 Tuition fees issues in the UK

University education in the UK has been discussed in detail in two previous chapters and a detailed summary of changes to the systems is presented in Table 3.1. In this paragraph, I would like to draw attention to the issue of tuition fees as the differences in them provide an important background for the question of university choice based on future income.

Table 3.1

OVERVIEW OF CHANGES TO HIGHER EDUCATION IN THE UK

1998

- Dearing Report 1997, which recommends the introduction of means tested tuition fees is implemented. Students have to pay £1000 per year upfront fees if parents earn over £35000 - **Whole UK**

2000

- Abolishment of tuition fees - **Scotland only**

2001

- Introduction of Graduate endowment-one off fee £2000 to be paid (income contingent) 10 months after graduation - **Scotland only**

2002

- HESA Dataset: **First Scottish cohort in the data enters university**

2003

- HESA Dataset: **First English and Welsh cohorts in the data enter university**

2004

- Announcement of Higher Education Act-most fees to be raised to £3000, (per year) but they are deferred and means tested, help available. It applied to students enrolling in 2006/2007 – **England and NI**

2006

- Implementation of Higher Education Act – **England and NI**
- Higher Education Act implemented with additional help for domestic students- **Wales**
- Increase in graduate endowment to £2289 – **Scotland**
- Scottish students have to pay tuition fees if they want to study in England or Wales
- Repayment for Graduate Endowment kicks in – **Scotland**
- HESA Dataset: **Last Scottish cohort started**

2007

- Graduate Endowment abolished - **Scotland**

For the first part of our sample, from 2003 till 2005, for students who enrolled in England and resided in England, tuition fees were up front though means-testing, and started at around £1,200 per year. Students whose parents earned less than £30,000 did not have to pay any tuition fees. In 2006, means-testing of tuition fees was removed and the tuition fees were increased to £3,000 per year[25]; however, all students became eligible for a student loan towards the fees, which they did not have to repay until they graduated and earnt at least £15,000 with the government subsidising the interest above the inflation level. As all students are eligible for the loan, the issue of credit constraint should not be of concern. Dearden *et al* (2004) shows credit constraints affect students in their decision to continue high school education, rather than in university participation decisions. Means-testing was moved towards support packages, to help with the cost of living, for example. With the 2006 increase of tuition fees in England, Scottish students who wanted to study in England had to pay the fees, but they could still study for free in Scotland. They were eligible for subsidised non-means-tested loans to study in England the same way the English were. Northern Irish and Welsh students were in generally the same situation as English, though additional grants were available to them.

3.4. Data

The data used in the study has been discussed to a large extent in chapter one and two and therefore, unless otherwise specified, the data is the same as in the previous chapters and this section will only briefly explain it. The sample size, and therefore the descriptive statistics, are the same as in chapter two. A summary of variables used can be found in Table 3.2.

[25] For an overview of the issues regarding tuition fees in England see Barr (2004)

Table 3.2

DESCRIPTION OF VARIABLES USED IN THE ANALYSIS

Variable	Description
Lndist	Natural logarithm of home/university distance
Manager	Socio-economic status dummy variable based on parental occupational background
Admin	Socio-economic status dummy variable based on parental occupational background
Skilled Trade	Socio-economic status dummy variable based on parental occupational background
Other	Socio-economic status dummy variable based on parental occupational background
Female	Dummy variable for female students
Age	Age variable, censored up to 16 and after 65 years of age
Test scores	Universities and Colleges Admissions Services Tariff
Income	Income 6 months after graduation for students' actual university of choice, approximated by an average per university per subject for the other possible choices
Tuition Fees	The amount depends on what years student enrolled, where is he from and where did he decide to study
Top20	Dummy if university is in the Top 20
RG	Dummy if university is in the Russell Group
Scotland	Dummy if university is in Scotland
Wales	Dummy if university is in Wales
NIreland	Dummy if university is in Northern Ireland

3.4.1. Individual characteristics

As salary information for students is required, this chapter only considers students whose salary is known after they graduate. This brings the sample down to just over 120,000. For about a quarter of students, I also hold a measure of test scores approximated by the Universities and Colleges Admissions Services tariff. Students whose income is known but whose test scores are missing are kept and their test scores are approximated by average scores of students who attended the same university and graduated with the same degrees. The socio-economic status (SES) variable consists of five categories: “Professional”, “Managerial”

“Administrative”, “Skilled trade” and “Other”, with “Other” including all occupations groups over skilled trade. “Skilled Trade” and “Administrative” are used as separate dummy variables when all SES are included in the model. Students’ from these backgrounds are combined as one dummy, when models are estimated per SES. All SES are based on parental occupational codes unless students are over 21 years of age.

3.4.2 University characteristics variables

Only universities who enrolled at least 100 students over four years are taken into account. Subsequently, the sample of universities drops to 126. This constraint is required for identifications of university alternative specific constants. I collect information on the address of each university and using these, I match them to regions and cities in the UK. There are twelve regions in the UK. Scotland, Wales and Northern Ireland each comprise one region, whereas England is made up of nine regions. London is considered a separate region. A dummy variable is used based on which country the university is located, whether it belongs to Top 20 or Russell Group or it is considered an Ancient university.

3.5 Cross border migration and changes in tuition fees

Due to changes in size of tuition fees over time, one of the ways attitudes towards income and tuition fees can be elicited is through student migration between the UK countries to study. Therefore, in this paragraph I discuss the cross border migration of students before and after the 2006 increase in tuition fees and issues pertaining to the changes in magnitude of university costs. The discussion is based on the data I have and migrations I observed.

Table 3.3
SCOTTISH AND ENGLISH STUDENTS' COUNTRY OF INSTITUTION BY ENROLMENT YEAR

Residency:	Scottish		English	
Country of Institution:	*England*	*Scotland*	*England*	*Scotland*
Year				
2003	3.91%	95.96%	93.85%	3.58%
2004	6.01%	93.81%	95%	1.81%
2005	6.62%	93.15%	96.02%	1.53%
2006	5.68%	94.16%	95.62%	1.29%

Source: HESA Student Record 2009/10 Copyright Higher Education Statistics Agency Limited 2011. The percentages present the proportion of students who in the given year of enrolment started education in a given country. The entire student population is used to calculate the percentages. The results for Northern Ireland and Wales are suppressed due to the small number of students. Only undergraduate student numbers are used.

When increases to tuition fees happen, there is always a worry regarding students' participation e.g McGuigan *et al* (2012).[26]; however, not a lot of analyses consider how changes to tuition fees would affect students' behaviour for individuals who decided to participate in higher education. The concern is that changes to tuition fees may, if not done carefully, have negative welfare effects for some groups of students. In this part of the paper, I am going to look at the difference in students' university choice pre and post tuition fees change, specifically the movement between the countries, in order to determine if a change in funding structure could have affected students' decision where to study. The assumption is that under any level of tuition fees, students are maximising their utility. If they expect high returns for attending a certain university, they

[26] As price of education increases, the supply in the UK is mostly fixed, but the demand is likely to fall.

should do so up to a level of fees, which would make the costs higher than the benefits, under the assumption that they are rational agents. If this assumption does not hold, one can imagine at least two different scenarios. First, for some students, the increase in tuition fees makes them change their university choice due to the perceived benefits of a degree. These students might choose a university which is cheaper and/or closer, to minimise the initial outlay. In this case, an increase in tuition fees could have a negative effect on students' lifetime wages since income maximisation would still hold for the initial choice for a rational agent. It is the issue especially, if the choice under lower fees was preferred, irrespective of what the reason for the decision was. This may lead to losses not only in student's welfare but to overall economic efficiency.

Secondly, changes to tuition fees could affect different groups differently, because, for example, some groups are more uncertain about the final results of higher education, or the information about degree returns vary between students. It is impossible to observe the first, but the data can inform us about differences in university choice based on location of different groups through observing how changes in tuition fees affected cross border migration of Scottish and English students between the respective countries over the time of the sample. It is expected that an increase in tuition fees will adversely affect Scottish students, i.e. it is expected fewer students choose to study in England. Table 3.3 shows there is a 0.94 percentage point drop in number of Scottish students, out of the whole population of Scottish students who decide to go to England in the year 2006. 2006 is the first year Scottish students had to pay tuition fees in England.

Although the number may seem insignificant, it is important to point out that the overall number of Scottish students who participated in higher education increased. This decrease represents a 6% decrease in Scottish[27] students who decided to study in England. Next, I look at the choice behaviour of English students. The last two columns of Table 3.3 show the country of institution of choice for English students. I observe a decrease in the number of English students who choose to study in Scotland. This result is probably a combination of the fact that English students have to pay for universities in Scotland and the fact that it takes four years to achieve a degree. I suppress the proportion of students who choose to study in Wales or Northern Ireland as the numbers are low and the results do not contribute to the discussion.

Table 3.4

SOCIO-ECONOMIC COMPOSITION OF SCOTTISH STUDENTS WHO CHOSE TO STUDY IN ENGLAND

Year	Professional	Managerial	Skilled Trade	Admin	Other
2003	56%	21%	7%	6%	10%
2004	48%	25%	7%	8%	12%
2005	50%	22%	7%	7%	14%
2006	49%	23%	7%	9%	12%

Source: HESA Student Record 2009/10 Copyright Higher Education Statistics Agency Limited 2011. The percentages represent the proportion of Scottish students from a given socio-economic class who chose to study in England, per year of enrolment.

Furthermore, I look more closely at the socio-economic composition of students who decide to study “across” the border. English students are left out of this discussion as the differences in fees they faced were much smaller, and initial

[27] This has been calculated using the total number of students who decided to study in England in 2005 minus the number of students who went to England in 2006, divided by the number of students who attended English universities in 2005. The exact numbers are suppressed for data sensitivity issues.

investigation suggests that there are very negligible differences between different socio-economic groups regarding whether to study in England or Scotland. Also, a large proportion of English students favour a small number of Scottish universities. Therefore, the focus is on Scottish domicile students as they faced the largest difference in fees between studying in England and Scotland. The statistics are presented in Table 3.4. The relative socio-economic composition of Scottish students stays very much the same over the years; the main difference is the decrease in students with parents from the "Professional" socio-economic group who decided to go to study in England and an increase in students from the "Administrative" background who do. The largest drop is observed amongst student from the "Other" background, which is the lowest SES. Also, though the total number of Scottish students studying in England is suppressed, it is important to point out that though the "Other" socio-economic group percentage participation has not changed much overall, there has been a substantial drop in total number of students who decided to study in England. This would mean the effect for the "Other" students was larger than the percentages suggest.

3.6 Discounted Future Income Streams

The negative attitudes towards tuition are often present in the media and suggest students see tuition fees as sizable costs. On the other hand, the supporters of tuition fees point out that graduates experience high private benefits. To contribute to the discussion on the validity of students' negative attitudes towards tuition fees, below, I compare the actual graduate incomes, which students could observe, with those of non-graduates using the Annual Survey of Household Earnings (ASHE). Specifically, I use regional incomes per occupation. Information is available on income for each out of 12 regions[28] but I aggregate them over four: England without London, London, Scotland and Wales. I also present results for the UK with and without London. I use earnings, which I assume could be observed by students at the time of enrolment to calculate their potential lifetime income after graduation. The calculated lifetime income is net the costs of university including forgone income of non-graduate earnings. It is done in the context of what is known so far from the data, presented in the earlier paragraph, on cross border migration with a focus on England and Scotland.

As wages did not change much over four years of the analysis, for simplicity wages from 2005 are used as observed wages both in 2005 and 2006. I choose secondary teachers' earnings for graduate earnings, as they are considered amongst the lowest which require a university degree. I calculate the present discounted values of teachers' wages at the time enrolment and compare them with discounted wages of shopping assistants[29]. For simplicity, I assume earnings to be constant over time i.e. an individual earns same wage every year of their working lifetime. The assumption does not affect the conclusions negatively as I end up calculating the average possible returns to university over a working life. I assume that the average working life is 40 years of uninterrupted work. Finally, I set the same discount rate for everyone at 2% per year. Detailed lifetime monetary

[28] Detailed per region information can be found in the appendix Table A2

[29] Detailed tables of how the costs of obtaining a university degree vary by region and by year can be found in the appendix table A1.

benefits of studying can be found in Table 3.5.

Table 3.5

LIFETIME EXPECTED EARNINGS NET OF INVESTMENT COSTS

	2005		2006		
	Secondary Teacher				Shop Assistant
	Studied in England (three years)				
	English	Scottish	English	Scottish	
London	£822,727	£826,177	£817,177	£817,177	£395,050
Wales	£778,365	£781,815	£772,815	£772,815	£318,953
Scotland	£743,459	£748,059	£743,359	£748,059	£314,617
England w/out London	£779,510	£782,960	£773,960	£773,960	£336,533
UK with London	£780,057	£783,612	£775,003	£775,430	£338,262
UK w/out London	£775,790	£779,355	£770,785	£771,255	£332,584
	Studied in Scotland (four years)				
London	£805,648	£809,098	£800,098	£800,098	
Wales	£762,326	£765,776	£756,776	£756,776	
Scotland	£727,858	£732,458	£727,758	£732,458	
England w/out London	£763,409	£766,859	£757,859	£757,859	
UK with London	£763,919	£767,473	£758,864	£759,291	
UK w/out London	£759,746	£763,311	£754,741	£755,211	

Source: The Annual Survey of Household Earnings (ASHE) 2005 Table 15.7a
Lifetime earnings are by region where wages are earned, chosen length of studying and nationality.
Yearly earnings in pounds sterling for year 2005. Discounted over 40 years starting from t=5 if studied 4 years (Scotland) and t=4 if studied 3 years (Rest of the UK). This accounts for no earnings over the time of studying. Discounted incomes are net of costs and forgone earnings of a shop assistant. Forgone and expected earnings vary by the region they are observed in. Costs vary by year of enrolment, country of student and country he chooses to study in. No investment costs assumed for shop assistant position.

In simple terms, an individual should find it attractive to study if the lifetime earnings of a teacher minus investment costs of studying are larger than lifetime earnings of a shop assistant given there are no other constraints like ability etc. The costs are calculated based on in which country students study and where he earns the wages. This simple exercise shows that studying in Scotland offers smaller lifetime returns both before and after the introduction of higher tuition fees, both for English[30] and Scottish students. In fact, English students will entertain the lowest lifetime earnings if they studied in Scotland and earned the wages in Scotland. This is because the Scottish university system is based on four year degrees, whereas the English system has three years and English students are required to pay fees at Scottish universities. Therefore, studying in Scotland is equally unattractive from the perspective of costs and returns for English students. Detailed costs can be found in Appendix A3.1. Scottish students would also be better off studying in England, even if they have to pay fees. In specific monetary terms, Scottish students, who study in Scotland, are around £15,000 worse off in comparison to the second worst scenario. This amount is similar for English students.

Also, it is important to point out that change in the size of tuition fees had little effect on the amount of lifetime earnings. The returns decreased on average by around £5,000. It is also important to point out that returns become identical for Scottish and English students for the UK regions bar Scotland, after the introduction of higher fees in 2006. This is the result of the fact that from 2006 Scottish students have to pay tuition fees in England as the rUK students. Finally, English students are a bit worse off on average if the whole UK returns are concerned, both with and without London, irrespective of where they studied.

[30] For simplicity, Welsh and Northern Irish institutions are not mentioned, as they are similar in set up to English. Therefore, similar conclusions apply.

This is driven by the fact that studying in Scotland for English students is especially costly due to forgone earnings. Finally, lifetime earnings of a Scottish student who studied in Scotland in 2006 and earned the wages in Scotland would earn £732,458 as a teacher. If he decided to become a shop assistant, it would be £314,617 over 40 years of working life.

An interesting picture develops from looking at the above information. Scottish students' returns are lower if they decide to study in Scotland. Before and after the introduction of higher tuition fees, and effectively fees for Scottish students to study in England, Scottish students are better off studying in England. It would imply that a utility maximising Scottish student, *ceteris paribus*, would always prefer to study in England. This effect is driven by, to some extent, the fact that Scottish students have to forgo four years of earnings in Scotland in comparison with three in England. This is true even when earnings for England are calculated without London, for which earning averages are much higher.

Using simple descriptive statistics carries many simplifications. For example, at the moment, I treat returns to university to be equal for all students as the monetary investment is, per country per residency status. In reality, the former is not true, but the latter holds. Because of the range of academic requirements across different courses, the effect may be accredited to ability, as well as, preference (Alstadsaeter 2011). Using an estimation method, I am able to control for it by using actual incomes after graduation as well as students' test scores as an approximation of the ability, as well as constrain their university of choice based on their subject upon graduation. A further extension would be to apply a

Roy (1951) sorting model, which would account for matching between ability and university in an alternative way. Not taking this into account, could potentially lead to overestimating results for some groups i.e. students who go to one of the top twenty universities would have higher wages, whether they studied at a chosen, selective university, or not. Additionally, though monetary investment can be assumed to be the same for students from the same country who studied in the same country, other costs, like moving, are not included in this paragraph. It may be that Scottish students choose to study in Scotland because of the high costs of moving to England. Using distance from home to institution at the time of enrolment helps us to control for it. Finally, the above information is abstracting from living costs. I am able to control for it using region specific dummies, which are included in the calculation of alternative specific constants.

In the following sections, I move on to discuss the identification of MUIs and briefly the model and methods used to deal with the shortcomings of descriptive analysis, in order to answer whether students underestimate their future incomes.

3.7 Identification strategy

The identification of MUIs is ensured in two ways. First, I exploit a natural experiment. The natural experiment used is the increase in the tuition fees in England, Wales and Northern Ireland to £3000 per year of study from just over £1000 per year, which affected all students in the UK. At the same time, the tuition fees remained at £0 for Scottish domicile students studying in Scotland.

The variation between the countries and within the time of our sample allows for a robust identification of marginal utilities of income.

Second, I use Berry, Levinshon and Pakes (1995) method to calculate alternative specific constants (ASC). Inclusion of ASCs ensures unobserved university characteristics are not correlated with other coefficients including income. Dealing with them is necessary as otherwise they may give biased estimate of marginal utility of income (MUI), and therefore incorrect estimates of discount factor. To improve identification further and to make the decision process more credible, I constrain students' choice set to a consideration set. The details on how consideration sets are generated can be found in chapter two. Briefly, it is unlikely that all students consider all universities as potential choices. To approximate this decision making process, a random draw out of all universities is made. The draw is conditional on the student's aggregated degree choice and ability, with each student's draw including their university of choice and a maximum of five alternative choices. This is not far from reality as the university application and admission process is centralised in the UK, with all students applying to universities using University and Colleges Admissions Services. Students were only allowed to apply to maximum of six universities, with application fees increasing only slightly with each university they apply to. This constraint on choice is taken into account when ASCs are calculated with details found in the Technical Appendix.

3.8 Methods and model

The discussion so far does not give clear information about students' attitudes towards incomes and tuition fees. A regression analysis is required, where I can control for, amongst other things, distance to university and test scores. First, I use a conditional logit model with alternative specific constants (CNL-ASC), which allows us to deal with unobserved university characteristics. This recognises that the decision of where to study may not be independent of other important aspects (unobserved characteristics e.g. lifestyle at a university, observed e.g. region) and account for them in our analysis. Secondly, I introduce choice constraint using same CNL-ASC.

The method used has been described in detail in the previous two chapters and this section will give a very brief overview. The model starts with typical conditional logit assumptions that a student i has a set of universities J to choose from, which includes all universities in the UK. Each students' utility of choice is driven by their socio-economic background, university characteristics, other demographics, income, fees and distance to university. The distance to university provides us with approximation of moving costs and is important because it maybe one of the factors, which cause e.g. Scottish students to stay in Scotland.

I start by describing students' utility in equations (1) and (2).[31]

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

[31] The framework I present below follows that of Murdock and Timmins (2007).

$$V_{ij} = \delta_j + \beta_2 X_j + (\beta_1 + \beta_3 Z_i) lndist_{ij} + \beta_4 X_j Z_i + \beta_5 lndist_{ij} X_j + \beta_6 tuitionfees_{ij} + \beta_7 Income_{ij} \quad (2)$$

$$\delta_j = \gamma X_j + \alpha \sigma_j + \xi_j \quad (3)$$

where V_{ij} is the observed component of utility U_{ij}, which consists of the natural logarithm of distance for each student i to university j, $lndist_{ij}$. X_j are the observed characteristics of university j, Z_i are the observed characteristics of individual i. ε_{ij} is the random utility component. $tuitionfees_{ij}$ are the fees a student would pay for studying at a university j given their residency status and the country in which the university is located. $Income_{ij}$ is the student's income given the university of choice j. The variable includes the actual income a student earns six months after graduation from a choses university. I cannot observe incomes of students at universities they did not study at, but I approximate it. In order to do so, I take the average income of students who studied a given subject at a given university. Equation (3) shows the decomposition of the alternative-specific constants. It includes: observed characteristics of universities X_j; the unobservable attribute of university choice ξ_j, which is assumed to be common across a group of students who studied at j university, and σ_j, which is the percentage of students, out of students in the sample, who decided to study at university j. In the rest of the paper, for simplicity, I call it the share. It is data derived.

The estimation strategy is as follows. In the first stage, we recover δ_j by the contraction mapping method first developed by Berry *et al* (1995). The contraction mapping updates the values on the parameters until the predicted share equals the actual share, which we calculated from the data.

$$P_{ij}^{m,q} = \frac{exp(V_{ij}^{m,q})}{\sum_{j=1}^{k} exp(V_{ik}^{m,q})} \tag{4}$$

In order to estimate the predicted share $\hat{\sigma}_j^{m,q}$, where *m* is the number of iterations required to recover δ_j (the alternative-specific constants) and q is the number of iterations needed to recover the rest of the parameters, I estimate the probabilities given in equation (4). Then, the predicted share of students who choose a specific university is equal to

$$\hat{\sigma}_j^{m,q} = \frac{1}{N} \sum_i P_{ij}^{mq} \tag{5}$$

Finally, given the parameters estimated in equation (5) the contraction mapping iterates the following function

$$\delta_j^{m+1,q} = \delta_j^{m,q} + (ln\sigma_j - ln\hat{\sigma}_j^{m,q}) \tag{6}$$

until a vector of δ_j is recovered, which equalises the predicted shares to the actual shares σ_j.

In the second stage of the estimation, I use the parameters and the alternative-specific constants from the contraction mapping to maximise the log likelihood function, as a parameter to be estimated

$$LL(\delta^{*q}, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7 \mid X, Z, dist) = \sum_{i=1}^{I} \sum_j y_{ij} \ln P_{ij}^{*} \quad (7)$$

In simple terms, the model introduces university-specific constants, which deal with unobserved university characteristics.

3.8.1 Calculation of the discount rate

In order to calculate the discount rate, I follow similar methodology to Hausman (1979). He calculates discount rates of costs and benefits of energy-using durables. Specifically, he estimates how households trade-off between costs of more energy efficient air conditioners. Since I deal with education not a good, the discounting is a bit more straightforward. I assume that tuition fees are the same for all students who decide to study in the same country given their residency status. The variable *MUfees* is the marginal utility of tuition fees of individual *i* studying at university *j* over three or four years (depending on the country of institution). I equal it to *MUincome*, which is the marginal utility of income. The final step is to discount the marginal utility of income with expression in denominator raised to power of 3 or 4 depending whether students studied in Scotland or rest of the UK.

Table 3.6

SUMMARY OF RESULTS

	CNL-ASC (1)	CNL-ASC (2)	CNL-ASC (3)	CNL-ASC (4)	CNL-ASC (5)	CNL-ASC (6)	CNL-ASC (7)
Lndist	-*	-*	-*		-*	-*	-*
Lndist* Manager	-***	-*	-*		-*	-*	-*
Lndist* Admin	-*	-*	-*		-*	-*	-*
Lndist* Skilled Trade	+	-	-		-	-	-
Lndist* Other	-*	-*	-*		-*	-*	-*
Lndist* Female	-**	+**	+***		+**	+***	+***
Lndist* Age	-	+	+		-	+	+
Lndist*Test scores					-*		
Income	+*	+*	+*	+*	+*	+*	+*
Tuition Fees	-*	-*	-*	-*	-*	-*	-*
Lndist* Top20	+*	-*			+	-*	
Lndist*RG			+***				
Top20				-		-*	
Top20* Manager				-			
Top20* Admin				-			
Top20* Skilled Trade				-			
Top20* Other				-			
Top20* Female				-*			
Top20* Age				+*			
Scotland							+*
Wales							+*
NIreland							+*

Coefficients' significance: * significant at 1%, ** significant at 5%, ***significant at 10%

$$-MUfees = \frac{MUincome}{(1+r)^n}$$

In order to estimate the above equation I use the coefficients results on *tuitionfees* and *income* from the regressions and substitute them into the above formula and solve for *r*.

3.9 Results

3.9.1 Estimation results for all socio-economic groups together

The results of the analysis are presented below. In order to investigate students' attitudes towards incomes and tuition fees, I estimate seven models. In all tables, the first two columns represent university attributes and the third table includes individual specific attributes. When variables are presented next to each other they represent an interaction. The first two models, CNL-ASC(1) and CNL-ASC(2), both use the same variables but CNL-ASC(1) is estimated without constraining the choice to consideration set of six. All following models are estimated with choice restriction and are done in order to see if estimates on *Income* and *TuitionFees* are sensitive to different specification. CNL-ASC(3) is estimated with *RG* dummy interaction instead of *Top20*. CNL-ASC(4) shows the importance of distance in the specification by estimating a model without it. CNL-ASC(5) includes the approximation of students' test scores in the estimation. CNL-ASC(6) includes *Top20* dummy on its own, as well as, interacted with *lndist.* CNL-ASC(7) includes country dummies for universities. A summary of the estimations and specifically signs of coefficients and significance can be found in Table 3.6.

Table 3.7 presents the results for CNL-ASC(1). The coefficient on distance variable, *lndist*, is -0.0727 and statistically significant at 1%. Coefficients on *SES*lndist* interactions are all negative and statistically significant apart from *Skilled Trade*, which is both positive and insignificant. Similar to what was

Table 3.7
CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – NO CHOICE CONSTRAINT

University Attribute		Individual Attribute	CNL-ASC(1)	
Lndist			-0.0727*	(0.0176)
Lndist		Manager	-0.0140***	(0.0080)
Lndist		Admin	-0.0328*	(0.0117)
Lndist		Skilled Trade	0.0129	(0.011)
Lndist		Other	-0.0479*	(0.0092)
Lndist		Female	-0.0162**	(0.0068)
Lndist		Age	-0.0064	(0.0083)
Income			1.3448*	(0.0051)
Fees			-1.3041*	(0.0258)
Lndist	Top20		0.0789*	(0.0083)
Log likelihood			-558128	
ρ^2			0.090	
Discount rate if studied 3 years			1.00%	
Discount rate if studied 4 years			0.77%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%
The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and Region dummies, as well as data derived share.

observed in chapters one and two, students from lower SESs have a negative utility of distance in comparison to the reference group, *Professional*. *Lndist*Age* interaction is also insignificant. Interaction of *lndist*Top20* is positive and significant at 1%, which means students are willing to travel to university if this university is in the Top20. Finally, *Income* and *TuitionFees* are statistically significant at 1% and stand at 1.3448 and -1.3041 respectively.

The results of CNL-ASC(2) can be found in Table 3.8. There are a few important difference between CNL-ASC(1) and CNL-ASC(2). Four coefficients changes signs: *lndist*Top20*, *lndist*SkilledTrade*, *lndist*Age*, *lndist*Female*. The first two interactions changed signs from positive in CNL-ASC(1) to negative in CNL-ASC(2), and vice versa for *Age* and *Female* interactions also, only *lndist*Top20* and *lndist*Female* continue to be statistically significant. Another major difference is in size of the *Income* coefficient. It continues to be highly significant but it decreased to 0.2097. Finally, ρ^2 has improved significantly, from 0.090 in the no choice restriction model CNL-ASC(1) to 0.255 in the choice constrained model CNL-ASC(2). It suggests generating consideration sets for students is an important contribution to explaining students' university choice in general, and attitudes towards costs and incomes in specific. It also suggests that without consideration set the results might be mis-specified, since four coefficients changed signs between CNL-ASC(1) and CNL-ASC(2) .

To investigate students attitudes towards incomes further, results CNL-ASC(3) are presented. It has a similar specification to CNL-ASC(2) with *RG* dummy interaction instead of *Top20.* It is estimated in order to determine if using a different variable for university quality can have an effect on *Income* coefficient. These results can be found in Table 3.9. In comparison with *lndist*Top20,* *lndist*RG* is positive, though only significant at 10%. It would suggest that students are willing to travel to universities, which belong to this prestigious group in comparison to only being a Top20 university; however, *Income* and other coefficients have hardly changed There is no change to ρ^2.

Table 3.8

CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – CHOICE CONSTRAINT

University Attribute		Individual Attribute	CNL-ASC(2)	
Lndist			-0.0849*	(0.0107)
Lndist		Manager	-0.0282*	(0.0091)
Lndist		Admin	-0.0562*	(0.0138)
Lndist		Skilled Trade	-0.0065	(0.0133)
Lndist		Other	-0.0730*	(0.0112)
Lndist		Female	0.0161**	(0.0082)
Lndist		Age	0.0045	(0.0058)
Income			0.2097*	(0.0071)
Tuition Fees			-1.2472*	(0.0326)
Lndist	Top20		-0.5053*	(0.0091)
Log likelihood			-167830	
ρ^2			0.255	
Discount rate if studied 3 years			-45%	
Discount rate if studied 4 years			-36%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes, the third column represents students' attributes. Reference socio-economic group is "Professional". ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Table 3.10 presents results for CNL-ASC(4), which is a model without the distance variable. Instead of distance, I interact students' attributes with *Top20* university attribute. There is hardly any change in the size of both *TuitionFees* and *Income* coefficients. Interestingly, *Age* and *Female* interaction are the only other two significant coefficients. *Top20**Age* interaction is positive as *lndist *Age* in

CNL-ASC(2) and (3) but it gains significance in this specification. *Top20* Female* changes sign back negative. This suggests that if distance is not a concern, older students get more utility out of *Top20* universities. On the other hand, it appears women get negative utility from attending *Top20* universities, even though as CNL-ASC(2) they are more likely to travel for university in general. ρ^2 has slightly decreased to 0.254.

Table 3.9

CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – CHOICE CONSTRAINT

Russell Dummy instead of Top20

University Attribute		Individual Attribute	CNL-ASC(3)	
Lndist			-0.0858*	(0.0107)
Lndist		Manager	-0.0281*	(0.0093)
Lndist		Admin	-0.0560*	(0.0142)
Lndist		Skilled Trade	-0.0063	(0.0136)
Lndist		Other	-0.0728*	(0.0115)
Lndist		Female	0.0162***	(0.0084)
Lndist		Age	0.0046	(0.0060)
Income			0.2098*	(0.0071)
Tuition Fees			-1.2470*	(0.0328)
Lndist	RG		0.0020***	(0.0012)
Log likelihood			-167830	
ρ^2			0.255	
Discount rate if studied 3 years			-44%	
Discount rate if studied 4 years			-36%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes, the third column represents students' attributes. Reference socio-economic group is "Professional". ASCs include RG dummy, Ancient dummy and region dummies, as well as data derived share.

CNL-ASC(5) estimation in Table 3.11 presents the effect on the model of the inclusion of test scores interacted with the distance variable. The sizes of most coefficients are comparable to CNL-ASC(2). The only difference between the two models is the inclusion of the test scores interaction. The two coefficients, which differ in size and sign are again those on *lndist*Age* and *lndist*Top20*. *lndist*Age* becomes negative though insignificant as it is in CNL-ASC(1). On the other hand, *lndist*Top20* becomes positive and insignificant, where it is significant in CNL-

Table 3.10

CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – CHOICE CONSTRAINT

No distance

University Attribute	Individual Attribute	CNL-ASC(4)	
Top20		-0.4524	(0.2811)
Top20	Manager	-0.2502	(0.2968)
Top20	Admin	-0.4408	(0.0306)
Top20	Skilled Trade	-0.2938	(0.0325)
Top20	Other	-0.2989	(0.0262)
Top20	Female	-0.5381*	(0.0193)
Top20	Age	0.3410*	(0.0146)
Income		0.2100*	(0.0072)
Fees		-1.2538*	(0.0326)
Log likelihood		- 168058	
ρ^2		0.254	
Discount rate English students		-45%	
Discount rate Scottish Students		-36%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes, the third column represents students' attributes. Reference socio-economic group is "Professional". ASCs include RG dummy, Ancient dummy and region dummies, as well as data derived share.

ASC(1). The coefficient on *lndist*TestScores* is surprisingly negative and statistically significant. There are a few potential explanations for this result. First, though unlikely, students with higher test scores have negative utility of distance, i.e. are less willing to travel to university. Second, it may be due to measurement error in the test scores variable itself, which is approximated for some students per subject per university average, due to missing data. Finally, it is possible there is an endogeneity problem with this specification as the choices are already constrained to six, with the consideration set based on test scores, especially since some results seem to change signs back to CNL-ASC(1) specification. The inclusion of the test scores interaction does not have much of an effect on *Income* or *TuitionFees* coefficient. ρ^2 is unchanged.

Table 3.11
CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – CHOICE CONSTRAINT
Test Scores

University Attribute		Individual Attribute	CNL-ASC(5)	
Lndist			-0.0634*	(0.0122)
Lndist		Manager	-0.0276*	(0.0084)
Lndist		Admin	-0.0568*	(0.0135)
Lndist		Skilled Trade	-0.0071	(0.0131)
Lndist		Other	-0.0747*	(0.0107)
Lndist		Female	0.0177**	(0.0082)
Lndist		Age	-0.0004	(0.0037)
Lndist		Test Scores	-0.1374*	(0.0254)
Income			0.2094*	(0.0071)
Fees			-1.2386*	(0.0327)
Lndist	Top20		0.0011	(0.00091)
Log likelihood			-167816	
ρ^2			0.255	
Discount rate if studied 3 years			-45%	
Discount rate if studied 4 years			-36%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%
The first two columns represent university attributes, the third column represents students' attributes. Reference socio-economic group is "Professional". ASCs include RG dummy, Ancient dummy and region dummies, as well as data derived share.

Table 3.12 includes results for specification CNL-ASC(6), which includes a dummy variable *Top20* into the model. It again has no effect on the results on *income* and *tuitionfees*. The interaction of *lndist*Top20* is negative and statistically significant as in CNL-ASC(2). The *Top20* dummy is also negative and statistically significant at 1%. These results suggest that students have a negative utility of attending *Top20* universities and are less likely to travel to

Table 3.12
CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – CHOICE CONSTRAINT
Top20 specification 2

University Attribute		Individual Attribute	CNL-ASC(6)	
Lndist			-0.0848*	(0.010)
Lndist		Manager	-0.0282*	(0.009)
Lndist		Admin	-0.0561*	(0.013)
Lndist		Skilled Trade	-0.0065	(0.013)
Lndist		Other	-0.0728*	(0.011)
Lndist		Female	0.0161***	(0.008)
Lndist		Age	0.0027	(0.005)
Income			0.2098*	(0.007)
Fees			-1.2471*	(0.032)
	Top20		-0.2284*	(0.014)
Lndist	Top20		-0.5027*	(0.009)
Log likelihood			-167830	
ρ^2			0.255	
Discount rate if studied 3 years			-45%	
Discount rate if studied 4 years			-36%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%
The first two columns represent university attributes, the third column represents students' attributes. Reference socio-economic group is "Professional". ASCs include RG dummy, Ancient dummy and region dummies, as well as data derived share.

them. One of the reasons for these results might be the higher requirements these universities set. The other coefficients remain similar in size, sign and significance as in the previous model. *Lndist*Age* interaction is positive and insignificant as in CNL-ASC(2) and (3). The coefficient on *lndist*Female* is also the same as in these two specifications and is positive and weakly significant.

Table 3.13

CONDITIONAL LOGIT WITH ASCS ESTIMATION RESULTS – CHOICE CONSTRAINT

Country of the institution

University Attribute	Individual Attribute	CNL-ASC(7)	
Lndist		-0.0812*	(0.009)
Lndist	Manager	-0.0282*	(0.009)
Lndist	Admin	-0.0581*	(0.013)
Lndist	Skilled Trade	-0.0043	(0.013)
Lndist	Other	-0.0728*	(0.011)
Lndist	Female	0.0161***	(0.008)
Lndist	Age	0.0026	(0.005)
Income		0.2099*	(0.007)
Fees		-1.2469*	(0.032)
Wales		0.4650*	(0.179)
Scotland		0.6644*	(0.163)
NIreland		0.274*	(0.103)
Log likelihood		-167830	
ρ^2		0.255	
Discount rate if studied 3 years		-45%	
Discount rate if studied 4 years		-36%	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes, the third column represents students' attributes. Reference socio-economic group is "Professional". ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

The results for specification CNL-ASC(7) are presented in table 3.13. The specification includes dummies for country of the institution with English institutions being the reference group. They are positive and statistically significant, which suggests students have higher utility from attending universities not in England. The possible reason for this maybe because for Scottish and Welsh students it is cheaper to study in their home countries.

3.9.2 Estimation of separate results for each socio-economic group.

The next step is the calculation of discount rate separately for each socio-economic group. Therefore, I run two specifications on each socio-economic group. As the expectation is that tuition fees and income coefficients will be different for each socio-economic group when calculated separately, I supress the other results, as stability of the coefficient sizes is not a concern and therefore only coefficients on income and tuition fees are presented. The two specifications estimated again are CNL-ASC(6) and CNL-ASC(7), that is four models are run per each specification: “Professional”, “Manager”, “Skilled trade and Admin” and “Other”.

Table 3.14

ESTIMATION RESULTS – CNL-ASC(6)

Model	Tuition Fees		Income		Discount rates
Professional	-1.422*	(0.065)	1.147*	(0.012)	-7%/ -5%
Manager	-1.487*	(0.085)	0.723*	(0.014)	-21%/ -16%
Skilled trade + Admin	-1.258*	(0.076)	1.060*	(0.017)	-5%/ -4%
Other	-1.578*	(0.072)	0.931*	(0.017)	-16%/ -12%

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

All specifications also includes: interactions of *lndist* with age and dummies for female and Top20, with Top20 dummy interacted with *lndist* and on its own. Discount rates column presents discounts rates calculated at three and four years respectively, in each column. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Table 3.15

ESTIMATION RESULTS – CNL-ASC(7)

Model	Tuition Fees		Income		Discount rates
Professional	-0.482*	(0.060)	0.873*	(0.012)	21% / 16%
Manager	-1.469*	(0.079)	0.723*	(0.014)	-21%/16%
Skilled trade + Admin	-1.355*	(0.080)	1.060*	(0.017)	-5%/-4%
Other	-1.561*	(0.076)	0.931*	(0.017)	-16%/12%

All specifications also include the country of institution with English institutions being the reference group as well as interactions of *lndist* with age and female.
Discount rates column presents discounts rates calculated at three and four years respectively, in each columns. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Table 3.14 holds estimation results for CNL-ASC(6). All coefficients on *tuitionfees* and *income* are the right signs and statistically significant at 1%. In general, the sizes are also similar in both cases with *tuitionfees* coefficient varying from -1.258 for "Skilled trade and Admin" model to -1.578 for "Other" and *income* coefficient varying from 0.723 for "Manager" model and 1.147 for "Professional".

Results for CNL-ASC(7) are presented in Table 3.16. They are essentially identical to the CNL-ASC(6). The only exception is the "Professional" model where the *tuitionfees* is -0.482 and *income* coefficient is 0.873.

The next step is the discussion of the discount rates, which are presented with the estimation results.

3.9.3 Discount rates

The calculated discount rates are presented in tables with the estimations, each with respective estimation. Discount rates for CNL-ASC(1), the specification without the consideration set, is the only discount rate which differs from all other specification, which include consideration sets. In CNL-ASC(1), the discount rate is 1.00% and 0.77% if a student studied in rUK or Scotland respectively. These seem to be plausible magnitudes and they would suggest students have rational attitudes towards their incomes and tuition fees. Irrespective of all the media publicised protests, students decide to study because they highly value their future benefits of holding a degree. This of course does not take into account the fact that students are a biased group of people to be asked about the value of university education i.e. if they decided to go, it means they value it highly.

A different picture is painted by the discount rates from the following six specifications. The discount rates stand at -44% and -36% depending on if a student studied for three (rUK) or four years (Scotland). This suggests that students do not value the present at all and put all the weight on the future. Another reason for this result may be linked to over-education, i.e. students actually overestimate their future incomes. The number turns negative after using consideration sets. It suggests additional underlying complexities in university choice, which require further investigation.

The results calculated per socio-economic group presented in Table 3.14 and Table 3.15 present similarly negative results though they vary substantially between different socio-economic groups from -21% to -4%. This suggests that there are important variations in what drives different socio-economic groups of students' university choices. Also, for specification CNL-ASC(7), discount rates are 21% and 16% for “Professional” depending on if they studied three or four years. It suggests that students from this socio-economic group discount their future incomes a lot.

In general, the negative discount rate maybe due to the issue of students' income expectations. When they start university, they have an idea about income, which is often based on what their parents earn. So in a way, what the discounts are showing is a discrepancy between what students expected to earn and what they earn after graduation. This would explain why the ‘Professional' background students are the only ones with positive discount rate. Let's imagine a student, whose parents are doctors, and who graduates and earns £25,000. This is an income substantially below what they are used to. Vice-versa if a student is from the “Skilled Trade and Admin” background. This explains why their discount rates are negative, as their income expectations are lower than what they earn after graduation.

It appears that the calculated discount rates are pointing to another issue in university choice, which can affect where and what students' study, i.e. their expectations. The results suggest that students from the highest socio-economic background have the highest expectations and as such, university education may not be helping much with mobility if other students' expectations are much lower.

3.10 Conclusions

This study contributes to the literature by calculating students' discount rates of graduate incomes using tuition fees and incomes they earn six months after graduation. The MUIs results using consideration sets are stable to various model specifications used, which gives confidence they are robustly identified. This paper also contributes further to the discussion of what drives students' university choices, by using the MUIs to calculate the discount rates of students of the costs and benefits of attending a university.

The estimation without the use of consideration sets suggest students have rational attitudes towards their future incomes, given the tuition fees they have to pay. Discount rates returned from the results with consideration sets suggests students either extremely value the future returns of their degree and overestimate their future earnings or discount their future incomes quite heavily. Investigation of the discount rates separately for each socio-economic group suggests it may be the issues of income expectations that affect the discount rate so negatively.

Nonetheless, these results may be due also to data limitations, even though they do not suffer from misspecification bias, as such. The income information is the wage six months after graduation and I do not know life time incomes or wage trajectories and these may underestimate students' discount rates for some groups and overestimate them for others. Therefore, there are potential extensions, which could improve the results in order to see if students actually overestimate their returns to schooling. One potential problem may be heterogeneity of preferences, which could be dealt with using random coefficients framework, though sample size may be an issue in this case. Also, there appears to be scope for investigating other groups of students separately i.e. women and older students, as the above analysis suggests these groups university choice is sensitive to various estimation methods. Also, based on students' degree information and occupation after graduation, assumptions can be made about lifetime earnings and potential income trajectories, which could inform the discussion on discount rates further.

Finally, students who are unemployed, volunteer or are in further education are at the moment excluded from the discussion. A study of those students, six months after graduation may provide additional information on the issue of student attitudes towards future incomes.

Conclusions to the thesis

University education is supposed to be a chance for individuals from lower socio-economic backgrounds to improve their future, in the widest sense of the word. It is supposed to be an equaliser, where it does not matter what background one is from, what matters is future expectation of improvement. The results of my study suggest students from lower socio-economic backgrounds choose universities differently and have lower expectations than their counter-parts from the highest socio-economic backgrounds. It means expanding higher education without dealing with these issues is likely to benefit only students from the highest backgrounds. Scotland, where education is free, has been a good example of this.

As benefits are high so are costs, and my research shows that without a good policy, little in terms of promoting mobility will be done.

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APPENDIX 1.A

Table 1A.1

UNIVERSITY NAME CHANGES

Old name	New name
The London Institute	University of Art, London*
St Martin's College	University of Cumbria, St Martin's College**
University of Paisley	University of West of Scotland
University of Central England in Birmingham	Birmingham City University
King Alfred's College, Winchester	University of Winchester
Napier University	Edinburgh Napier University
University of Kent at Canterbury	University of Kent
South Bank University	London South Bank University
University of Luton	University of Bedfordshire***
Queen Mary, University of London	Queen Mary and Westfield College
University of Wales, Bangor	Bangor University
Chester College of Higher Education	University of Chester
The University of the Highlands and Islands Project	UHI Millenium Institute
North East Wales Institute of Higher Education	Glydwr University
College of St Mark & St John	University College Plymouth St Mark and St John
University of North London	London Metropolitan University
London Guildhall University	London Metropolitan University
Bolton Institute of Higher Education	University of Bolton
University of Manchester Institute of Science & Technology	University of Manchester
University of Wales College of Medicine	Cardiff University

* Two names for the same institution
**Consolidation of campuses
***Change of name plus a merger with Luton campus of De Manford university

APPENDIX 2.A

Table 2.5

FULL ESTIMATION RESULTS – CNL-ASC(1) –ALL TOGETHER

Top20

University Attribute		Individual Attribute	CNL-ASC(1)	
Lndist			-0.0813*	(0.0099)
Lndist		Manager	-0.0283*	(0.0094)
Lndist		Skilled and Admin	-0.0316*	(0.0106)
Lndist		Other	-0.0728*	(0.0112)
Lndist		Female	0.0159**	(0.0082)
Lndist		Age	0.0027	(0.0052)
Income			0.2099*	(0.0071)
Fees			-1.2471*	(0.0326)
	Top20		-0.0337*	(0.0080)
Lndist	Top20		-0.4730*	(0.0092)
Log likelihood			-167826	
ρ^2			0.26	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.6

FULL ESTIMATION RESULTS – CNL-ASC(1) –PROFESSIONAL

Top20

University Attribute		Individual Attribute	CNL-ASC(1)	
Lndist			0.0010	(0.0030)
Lndist		Female	0.0049	(0.0175)
Lndist		Age	0.0085	(0.0058)
Income			1.1477*	(0.0129)
Fees			-1.4224*	(0.0655)
	Top20		1.0499*	(0.0242)
Lndist	Top20		-0.0052*	(0.0007)
Log likelihood			-55700	
ρ^2			0.35	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.7

FULL ESTIMATION RESULTS – CNL-ASC(1) –MANAGER

Top20

University Attribute		Individual Attribute	CNL-ASC(1)	
Lndist			-0.0679	(0.0052)
Lndist		Female	0.0124*	(0.0047)
Lndist		Age	-0.0029*	(0.0015)
Income			0.7233**	(0.0145)
Fees			-1.4877*	(0.0846)
	Top20		0.0437*	(0.0115)
Lndist	Top20		0.0990*	(0.0040)
Log likelihood			-1.3096	
ρ^2			0.27	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.8

FULL ESTIMATION RESULTS – CNL-ASC(1) –SKILLED AND ADMIN

Top20

University Attribute		Individual Attribute	CNL-ASC(1)	
Lndist			-0.0613*	(0.0075)
Lndist		Female	0.0005*	(0.0002)
Lndist		Age	-0.0060*	(0.0031)
Income			1.0604*	(0.0170)
Fees			-1.2528*	(0.0764)
	Top20		0.0002*	(0.0001)
Lndist	Top20		0.0270*	(0.0032)
Log likelihood			-1.3151	
ρ^2			0.27	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.9

FULL ESTIMATION RESULTS – CNL-ASC(1) –OTHER
Top20

University Attribute		Individual Attribute	CNL-ASC(1)	
Lndist			-0.0461*	(0.0077)
Lndist		Female	0.0404*	(0.0163)
Lndist		Age	0.0011*	(0.0004)
Income			0.9312*	(0.0178)
Fees			-1.5784*	(0.0724)
	Top20		1.7534*	(0.0297)
Lndist	Top20		-0.0218*	(0.0029)
Log likelihood			-1.3627	
ρ^2			0.24	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.10

FULL ESTIMATION RESULTS – CNL-ASC(2) –ALL TOGETHER

Country

University Attribute	Individual Attribute	CNL-ASC(2)	
Lndist		-0.0813*	(0.0097)
Lndist	Manager	-0.0283*	(0.0096)
Lndist	Skilled and Admin	-0.0316*	(0.0108)
Lndist	Other	-0.0728*	(0.0115)
Lndist	Female	0.0159**	(0.0084)
Lndist	Age	0.0027	(0.0054)
Income		0.2100*	(0.0071)
Fees		-1.2470*	(0.0328)
Wales		0.4651*	(0.1797)
Scotland		0.6645*	(0.1637)
N. Ireland		0.2740*	(0.1037)
Log likelihood		-167826	
ρ^2		0.26	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.11

FULL ESTIMATION RESULTS – CNL-ASC(2) –PROFESSIONAL

Country

University Attribute	Individual Attribute	CNL-ASC(2)	
Lndist		0.6505*	(0.0249)
Lndist	Female	-0.3683*	(0.0172)
Lndist	Age	-0.2510*	(0.0106)
Income		0.8729*	(0.0120)
Fees		-0.4828*	(0.0600)
Wales		-0.0350	(0.0246)
Scotland		0.1787*	(0.0216)
N. Ireland		0.1499*	(0.0354)
Log likelihood		- 1.1735	
ρ^2		0.34	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.12

FULL ESTIMATION RESULTS – CNL-ASC(2) –MANAGER

Country

University Attribute	Individual Attribute	CNL-ASC(2)	
Lndist		-0.0158*	(0.0011)
Lndist	Female	0.0110*	(0.0029)
Lndist	Age	-0.0152*	(0.0043)
Income		0.7214*	(0.0145)
Fees		-1.4696*	(0.0794)
Wales		-1.1006*	(0.0381)
Scotland		-1.0747*	(0.0398)
N. Ireland		-0.0234*	(0.0033)
Log likelihood		-1.3100	
ρ^2		0.27	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.13

FULL ESTIMATION RESULTS – CNL-ASC(2) –SKILLED AND ADMIN

Country

University Attribute	Individual Attribute	CNL-ASC(2)	
Lndist		-0.1054*	(0.0252)
Lndist	Female	-0.0037	(0.0031)
Lndist	Age	0.0188	(0.0132)
Income		1.0686*	(0.0168)
Fees		-1.3551*	(0.0801)
Wales		0.5427*	(0.0330)
Scotland		-1.4286*	(0.0323)
N. Ireland		0.8411*	(0.0339)
Log likelihood		-1.3151	
ρ^2		0.25	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

Table 2.14

FULL ESTIMATION RESULTS – CNL-ASC(2) –OTHER Country

University Attribute	Individual Attribute	CNL-ASC(2)	
Lndist		-0.0439*	(0.0050)
Lndist	Female	0.0393*	(0.0113)
Lndist	Age	-0.0011*	(0.0003)
Income		0.9305*	(0.0173)
Fees		-1.5615*	(0.0769)
Wales		5.6288*	(0.1129)
Scotland		-0.0403*	(0.0034)
N. Ireland		0.3321*	(0.0374)
Log likelihood		-1.3626	
ρ^2		0.25	

Standard errors in parentheses with * significant at 1%, ** significant at 5%, ***significant at 10%

The first two columns represent university attributes; the third column represents students' attributes. Reference socio-economic group is Professional. ASCs include Top20 dummy, Ancient dummy and region dummies, as well as data derived share.

Loglikelihood is normalised per number of observations.

APPENDIX 3.A

Table 3A1

COSTS OF STUDYING (TUITION FEES) INCLUDING FORGONE EARNINGS

Regions	2005 English students	2005 Scottish students	2006 English students	2006 Scottish students
North East	£39,588	£36,138	£45,138	£45,138
North West	£41,937	£38,487	£47,487	£47,487
Yorkshire and The Humber	£41,331	£37,881	£46,881	£46,881
East Midlands	£40,485	£37,035	£46,035	£46,035
West Midlands	£40,572	£37,122	£46,122	£46,122
East	£42,972	£39,522	£48,522	£48,522
London	£48,273	£44,823	£53,823	£53,823
South East	£44,457	£41,007	£50,007	£50,007
South West	£41,727	£38,277	£47,277	£47,277
Wales	£39,639	£36,189	£45,189	£45,189
Scotland	£52,196	£47,596	£52,296	£47,596

The amounts are in pound sterling and consist of forgone earnings in the region plus tuition fees. Forgone earnings are the average shop assistant wages per region and can be found in the ASHE 2005.

Table 3B2

TEACHERS WAGES

	Teachers wages per annum in 2005	*Teachers expected if studied in England*	*Teachers wages if studied in Scotland*	*Shop Assistant Wages*
UK average	£32,803	£823,073	£806,935	£12,948
UK average w/out London	£32,842	£818,281	£802,236	£12,579
North East	£34,678	£864,023	£847,082	£12,046
North West	£32,803	£817,307	£801,281	£12,829
Yorkshire and The Humber	£32,578	£811,701	£795,785	£12,627
East Midlands	£33,694	£839,506	£823,046	£12,345
West Midlands	£32,036	£798,196	£782,545	£12,374
East	£32,321	£805,297	£789,507	£13,174
London	£34,958	£871,000	£853,921	£14,941
South East	£32,743	£815,812	£799,815	£13,669
South West	£32,803	£817,307	£801,281	£12,759
Wales	£32,831	£818,004	£801,965	£12,063
Scotland	£31,934	£795,655	£780,054	£11,899

Source: The Annual Survey of Household Earnings (ASHE) 2005 Table 15.7a

Yearly earnings in pounds sterling for year 2005. Discounted over 40 years starting from t=4 for England and t=5 for Scotland. This accounts for no earnings over the time of studying, which is 3 years in England and 4 years in Scotland.

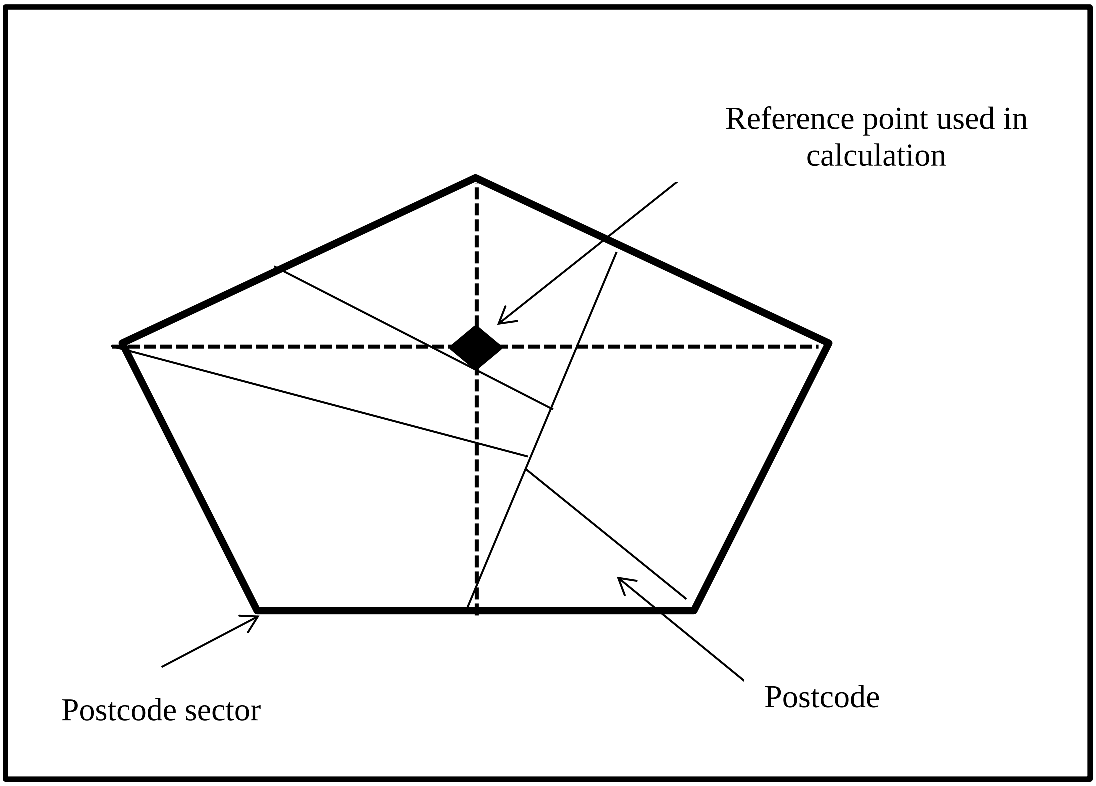
TECHNICAL APPENDIX

A1. Calculation of the distance matrix

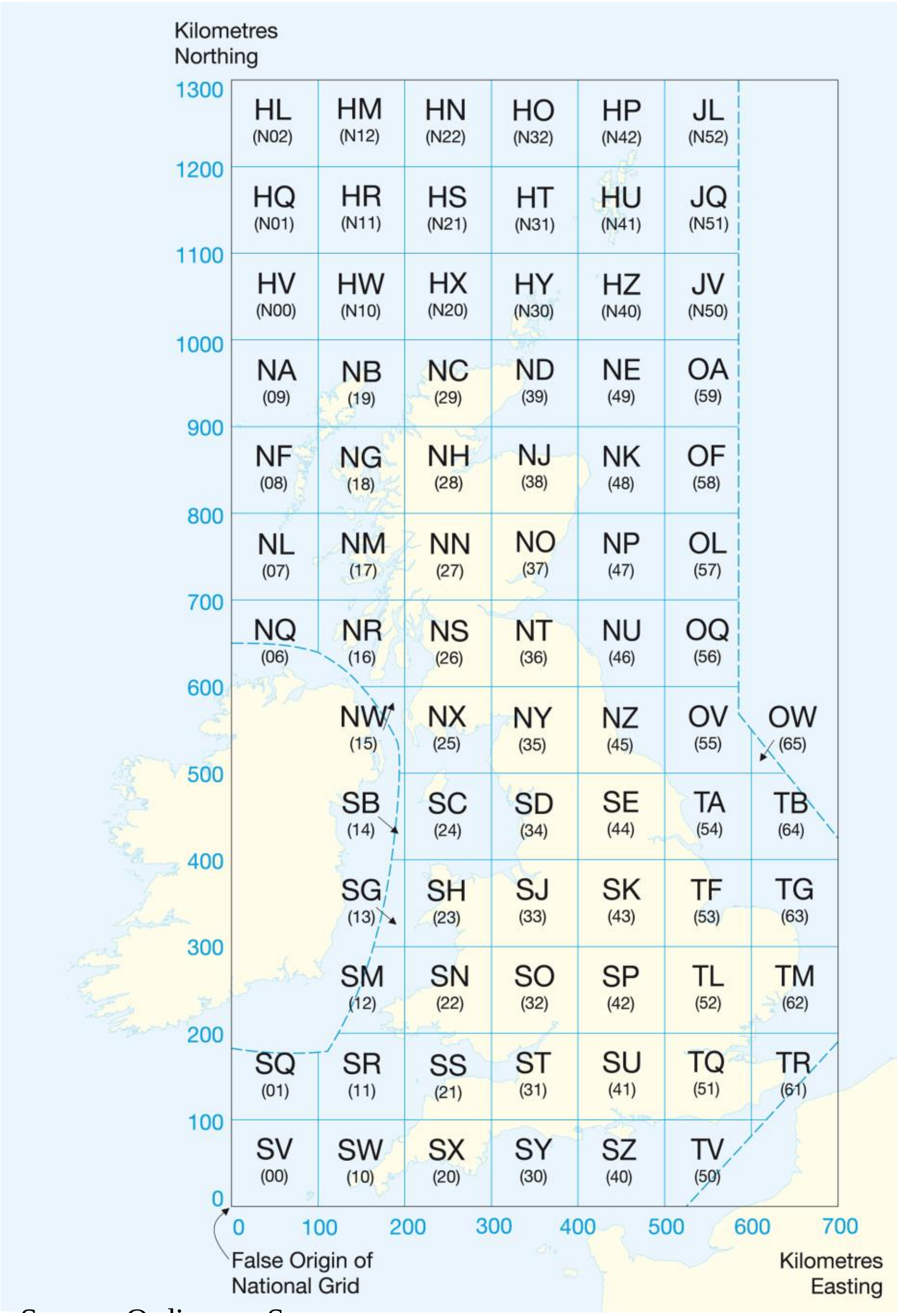
In order to calculate the distance I use the eastings and northings for each postcode in the UK, which can be accessed from UKBorders website. Easting refers to the eastward-measured distance (or the x-coordinate), while northing refers to the northward-measured distance (or the y-coordinate). The geography I have is on postcode sector level. In the sample, there are close to 9000 postcode sectors. In order to estimate the home/institution distance I first need to find the centre of each postcode. I do it by taking the minimum and the maximum of both eastings and northings from the group of postcodes, which belong to the postcode sector. Figure 1 presents a visual approximation of the process. Each corner of the pentagon represents easting or northing of a postcode sector, and the smaller shapes within the pentagon are the postcodes. Each corner or the pentagon represents either a maximum or a minimum of an easting or a northing out of all postcodes. The middle of the dashed crossed lines, marked with a black rhombus, represent where I would determine the centre of the postcode sector to be. I achieve this by calculating the mean of minimum and maximum of easting and northing. Once I calculate the easting and northing for the centre of each postcode sector, I apply the Pythagoras rule in order to calculate the distance. Pythagoras' theorem states that in a right-angled triangle, the length of the hypotenuse equals the sum of the square roots of the other two sides. As mentioned earlier, eastings lines are horizontal and therefore perpendicular with northings, which are vertical, the theorem can be used to calculate the distance between the two points (the hypotenuse).

Home-university distance =

$$sqrt\left(\left(university_{easting} - mean_{easting}\right)^2 + \left(university_{northing} - mean_{northing}\right)^2\right) \qquad \text{A1}$$



It is possible to calculate the distance using the simple Pythagoras rule because eastings and northings are on a flat surface, therefore more complicate calculations, which require an inclusion of the curvature of the Earth are not necessary. I then calculate the distance matrix, i.e. the distance between every postcode sector and every university. Using distance matrix allows us to condition the utility not only on the distance to every university of choice but the whole choice set of universities[32].



Source: Ordinance Survey

[32] For more details see: http://www.ordnancesurvey.co.uk/oswebsite/docs/maps/national-grid-map-with-numbering.pdf

A2. Identification in McFadden conditional logit framework

It is important to point out that for identification reasons all socio-economic variables are interacted have to be interacted with a variable, which varies by the alternatives. It is a characteristic of conditional logit model. For example, let d_i indicate the university choice a student *i* makes where $d_i \in \{1, \dots, J\}$. Students choose *d* to maximise their utility *U*.

A student's utility is described as

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

where V_{ij} represents observed factors to the utility individual i receives from choosing j, and ε_{ij} are unobserved to the econometrician but observed to the individual. Then

$$y_{ij} = 1 \; if \; V_{ij} + \varepsilon_{ij} > V_{ij'} + \varepsilon_{ij'} \quad for \; all \; j' \neq j$$

Since $\varepsilon' s$ unobserved, the probability of a student's i choosing a university j is given by:

$$P_{ji} = Prob\big(V_{ij} + \varepsilon_{ij} > V_{ij'} + \varepsilon_{ij'} \quad \forall \;\; j' \neq j\big)$$

$$= Prob(\varepsilon_{ij'} - \varepsilon_{ij} < V_{ij} - V_{ij'} \quad \forall \;\; j' \neq j)$$

$$= \int_{\varepsilon} I(\varepsilon_{ij'} - \varepsilon_{ij} < V_{ij} - V_{ij'} \quad \forall \;\; j' \neq j) f(\varepsilon) d\varepsilon$$

Where *I(.)* is and indicator function, equalling 1 when the expression in parentheses is true and 0 otherwise.

Continuing with university example, suppose a student i has $d_i \in \{1,2\}$ universities to choose from. Then

$V_{i1} = \alpha Male_i + \beta_1 X_i + \gamma Z_1$

$V_{i2} = \alpha Male_i + \beta_2 X_i + \gamma Z_2$

Since only differences in utility matter:

$$V_{i1} - V_{i2} = (\beta_1 - \beta_2)X_i + \gamma(Z_1 - Z_2)$$

What the above equation mean is that a conditional choice model cannot identify whether male students get more utility out of being male rather than female. The model can only identify the preference of male students given the difference in utilities between university 1 and university 2. In other words, individual characteristics do not vary by choice and therefore they can only be identified if they specified in ways that create differences in utility over alternatives. See Train (2009) for details.

As a result, all socio-economic information which does not vary by alternatives in the models is interacted with a university specific variable.

A3. Minimisation methods for estimating the log likelihood

I use two minimisation algorithms: BCPOL and BCONF. The below description of the algorithms follows that from IMSL Fortran Numerical Libraries, User's

Guide, Library/Math, Version 6. The two methods are always used in the same order, with the former used at the beginning as it is better at estimating coefficients without known magnitudes and the guesses on coefficients can be anything. BCONF is used once BCPOL returns results. BCONF is more efficient at estimating results once initial results are found. Below, I present detailed information on how the methods estimate the results. Explanation of both methods can be found in IMSL: Fortran Numerical Library: User's Guide: Math, Version 6.0.

BCPOL

The routine BCPOL uses the complex method to find a minimum point of a function of n variables. The method is based on function comparison; no smoothness is assumed. It starts with $2n$ points $x_1, x_2, \ldots, x_{2n}$. At each iteration, a new point is generated to replace the worst point x_j, which has the largest function value among these $2n$ points. The new point is constructed by the following formula:

$$x_k = c + \alpha(c - x_j)$$

where

$$c = \frac{1}{2n-1}\sum_{i \neq j} x_i$$

and $\alpha (\alpha > 0)$ is the *reflection coefficient*.

When x_k is a best point, that is, when $f(x_k) \leq f(x_i)$ for $i = 1,\ldots,2n$, an expansion point is computed $x_e = c + \beta(x_k - c)$, where β (β > 1) is called the *expansion coefficient*. If the new point is a worst point, then the complex would be contracted to get a better new point. If the contraction step is unsuccessful, the complex is shrunk by moving the vertices halfway toward the current best point. Whenever the new point generated is beyond the bound, it will be set to the bound. This procedure is repeated until one of the following stopping criteria is satisfied:

Criterion 1:

$f_{best} - f_{worst} \leq \varepsilon_f (1. + |f_{best}|)$

Criterion 2:

$$\sum_{i=1}^{2n}(f_i - \frac{\sum_{j=1}^{2n} f_j}{2n})^2 \leq \varepsilon_f$$

where $(f_i = f((x_i)$, $(f_j = f(x_j)$, and ε_f is a given tolerance. The full description of the method can be found in Nelder and Mead (1965) or Gill et al. (1981).

BCONF

The routine BCONF uses a quasi-Newton method and an active set strategy to solve minimization problems subject to simple bounds on the variables. The problem is stated as follows:

$\min_{x \in R^n} f(x)$

subject to $l \le x \le u$

From a given starting point x^c, an active set IA, which contains the indices of the variables at their bounds, is built. A variable is called a “free variable.” if it is not in the active set. The routine then computes the search direction for the free variables according to the formula

$$d = -B^{-1}g^c$$

where B is a positive definite approximation of the Hessian and g^c is the gradient evaluated at x^c; both are computed with respect to the free variables. The search direction for the variables in IA is set to zero. A line search is used to find a new point x^n ,

$$x^n = x^c + \lambda d, \qquad \lambda \in (0, 1]$$

such that

$$f(x^n) \le f(x^c) + \alpha g^T d, \qquad \alpha \in (0, 0.5)$$

Finally, the optimality conditions

$$||g(x_i)|| \le \varepsilon,\ l_i < x_i < u_i$$

$$g(x_i) < 0, x_i = u_i$$

$$g(x_i) > 0, x_i = l_i$$

are checked, where $\varepsilon,$ is a gradient tolerance. When optimality is not achieved, B is updated according to the formula:

$$B \leftarrow B - \frac{Bss^T B}{s^T Bs} + \frac{yy^T}{y^T s}$$

where $s = x^n - x^c$ and $y = g^n - g^c$. Another search direction is then computed to begin the next iteration.

The active set is changed only when a free variable hits its bounds during an iteration or the optimality condition is met for the free variables but not for all variables in IA, the active set. In the latter case, a variable that violates the optimality condition will be dropped out of IA. For more details on the quasi-Newton method and line search, see Dennis and Schnabel (1983). For more detailed information on active set strategy, see Gill and Murray (1976).

Although this algorithm gives better results, it is computationally intensive as it requires setting up bounds for each coefficient, which in practice amounts to updating both guesses on coefficients and their bounds until the maximum found.